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IRON AND STEEL ENGINEER

SEPTEMBER • 1938

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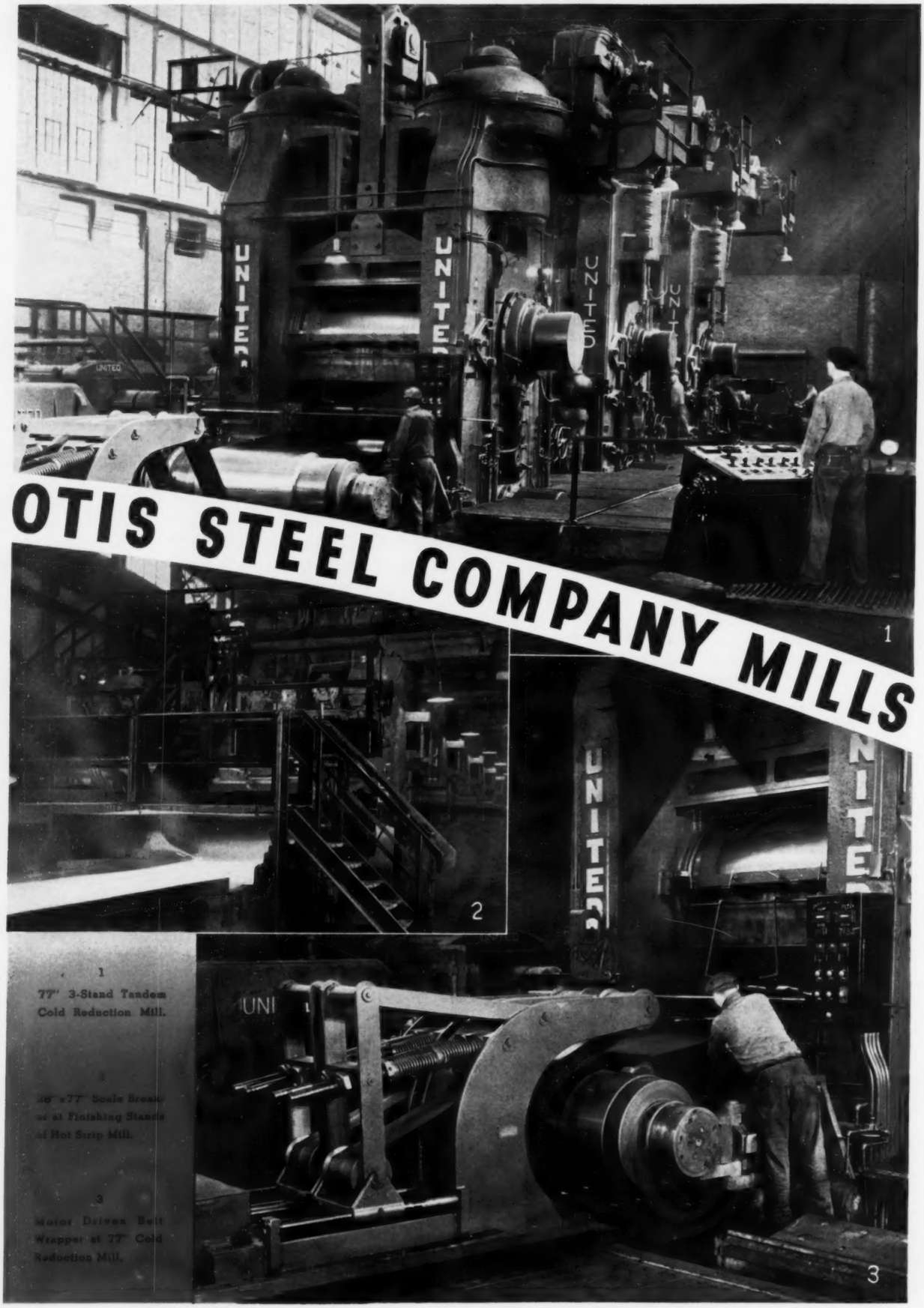


1
77" 3-Stand Tandem Cold Reduction Mill.

2
48" x 77" Scale Breaker at Finishing Stands of Hot Strip Mill.

3
Motor Driven Belt Wrapper at 77" Cold Reduction Mill.

OTIS STEEL COMPANY
MODERNIZES ITS
WIDE STRIP MILL

Otis --- N

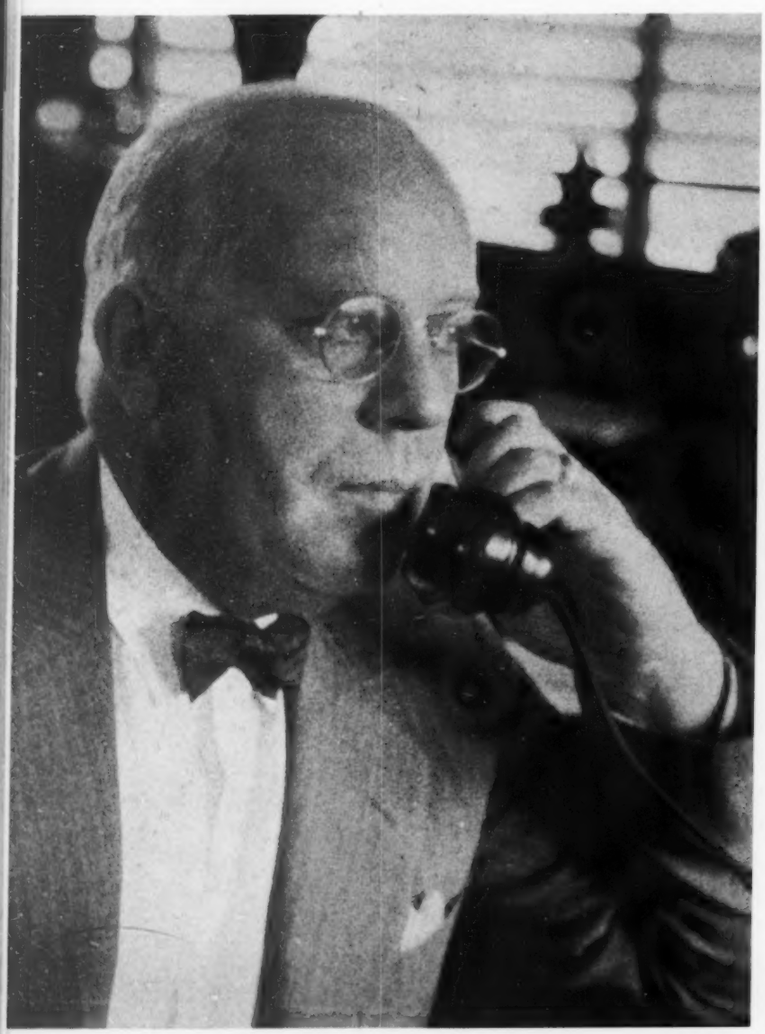
ITS WIDE S

▲ A PIONEER in the field of continuous wide strip rolling, the Otis Steel Company has recently completed a modernization program involving the hot and cold strip mills of their Riverside plant.

The original hot mill was of 72″ width, with a delivery speed of 1200 ft. per minute, and was made up of a scalebreaker, five roughing stands, and four finishing stands, with a vertical edging stand preceding each of the first three roughers. At the time of its construction in 1931, it was the largest continuous mill in the country.

The program just completed included the widening of the mill to 77″, stepping up the delivery speed to about 1600 ft. per min., and re-arranging the mill so as to conform to the conventional layout of scalebreaker, four roughers, a second scalebreaker, and six finishers. This required the moving of the fifth roughing stand, which was a four-high duplicate of the original finishing stands, to the position of No. 1 finisher, the addition of a new No. 6 finisher and a finishing scalebreaker, and the widening of tables throughout the mill. The work was greatly facilitated by the slotted shoe plates used in the original mill construction.

Cold rolling, pickling, annealing and finishing facilities have also been modernized and improved, together with other auxiliary equipment.



The project required far-reaching changes in the layout of switchgear, busses and controls. Two new 3500 hp. motors, a 6000 kw. motor-generator set, a 400 hp. motor, and a 1250 hp. motor were added on main drives, as well as a considerable number of smaller units. The increased power load necessitated far-reaching changes in the layout of switchgear, conduits and controls. Aluminum channel busses, high strength insulators and additional circuit breakers were installed. Variable frequency alternator sets for runout tables and coilers required changing to accommodate the higher mill speeds. Some building enlargement was also necessary. The program entailed a very considerable construction job, and the fact that it was completed without stopping production for more than a day at a time, except during one week when a complete change of gear reduction equipment was made, is ample proof of the foresignt and coordination entering into the job. As a result, this mill is one of the most efficient flat rolled steel production units in the country.

As it is now constituted, the modernized mill is capable of producing widths of 21″–74″ and gauges of No. 19 to ½″, and has a nominal capacity of 50,000 tons per month. Slabs, which may range 21″–44″ in width, 3¼″–7½″ in thickness, and 41″–156″ in length, are supplied from a 40″ reversing blooming mill which lays in line with the strip mill. A chain type conveyor takes slabs from the blooming mill shear table into the slab yard, where they may be cleaned and stored, or charged direct into the slab heating furnaces, the charg-

E. J. KULAS, President
THE OTIS STEEL CO.

---MODERNIZES

DE STRIP MILL

ing ends of which project back into the slab yard. A 50 ft. motor-driven charging table runs across the back ends of the furnaces.

HOT MILL

Heating facilities are comprised of two triple-fired zone-controlled continuous furnaces, with an effective hearth of 59′–2¼″ length by 14′ width. Of this length 13′–6″ is given over to soaking zone. The furnaces may be charged with either a single or a double row of slabs, depending on their length. An electrically driven double rack and pinion type pusher on each furnace propels the slabs through the furnace.

Each furnace has a rated capacity of 40 tons per hour, and is fired through luminous burners. Stabilized oil refinery gas has recently been adopted as fuel for these furnaces. It is composed of about equal parts of refinery gas, obtained from a near-by refinery, and air, and averages about 900 Btu. per cu. ft. Eleven burners spaced across the end of the furnace above the steel and ten more similarly spaced below the steel serve the main heating chamber, while nine burners overfire the soaking zone. The burners have a total capacity of 75,000 cu. ft. per hour per furnace. The average fuel input is about 54,000,000 Btu. per hour, with an average production of about 30 tons per furnace hour. Monthly fuel consumptions have averaged about 2,000,000 Btu. per ton, but with recently increased efficiencies ,indications are that, with resumption of normal production, fuel consumption will drop below 1,750,000 Btu. per ton.

No recuperation is provided, cold air for combustion being supplied to the burners by four motor driven fans.

The furnace discharge table, 58 ft. long, conveys slabs at temperatures averaging 2250 degrees F. to the hot mill. The roughing scalebreaker is a 2-high, 32″ x 76″ stand, driven by an 800 hp., 2300 volt, 600 rpm., (500 rpm. at full load), 60 cycle slip ring motor. Primary furnace scale is cracked loose from the slab by the light reduction in this pass, and is then removed by hydraulic descaling sprays. A new type of slab turning device has been installed on the delivery side of the scalebreaker. At a distance of 29 ft. from the scalebreaker is placed the first roughing stand, a 2-high, 32½″ x 76″ mill, driven by a 1200 hp., 2300 volt, 214 rpm., (198 rpm. at full load) 25 cycle slip ring motor. This stand may be used for cross rolling on slabs up to about 6 ft. in length. The slab pusher and slab squeezer usually employed on broadside mills are not provided on this installation. The second and third roughers are also 2-high, 33″ x 76″ stands, but driven respectively by a 1600 hp., 2300 volt, 600 rpm., (560 rpm. at full load), 60 cycle slip ring motor, and a 2000 hp., 2300 volt, 214 rpm., (198 rpm. at full load), 25 cycle motor. The fourth rougher is a 3-high, 22½″ and 30½″ x 77″ stand driven by a 3000 hp., 6600 volt,

Glowing steel enters the newly installed finishing scalebreaker on its way to the finishing train extending off into the background.

J. E. MONTGOMERY

VICE PRESIDENT AND GENERAL MANAGER

375 rpm., (350 rpm. at full load), 25 cycle motor. This stand was originally a jobbing plate mill, and was incorporated into the original strip mill at the time of its construction. The strip passes between the middle and bottom rolls, just as in plate mill practice. The roughers are spaced 30′, 27′–6″ and 37′–6″ apart, respectively.

A delay table 89 ft. long separates the roughing and finishing trains. The first unit of the latter is a 2-high, 28″ x 77″ scalebreaker, driven by a 400 hp., 300/1050 rpm., 600 volt shunt motor, and is spaced 15 ft. ahead of the finishing train. The first five finishing stands are 4-high, 21″ and 46⅝″ x 77″ units, while the last stand is 21″ and 50″ x 77″. Back-up rolls originally were 45″ diameter, are now 46⅝″ diameter on the first five finishers, and all future replacements will be of 50″ diameter, duplicating those on the new No. 6 finisher. These stands are spaced on 21 ft. center lines. Each finisher is driven by a 3500 hp. motor of 175/350 rpm. except the last which is provided with a 2500 hp., 200/400 rpm. motor. All of these motors are of 600 volts d-c. shunt wound.

The first three roughers are each preceded by a separate vertical edging stand, with rolls 20″ in diameter x 11″ in length, driven by a 150 hp., 600/900 rpm., 250 volt compound motor with field control. Although the edgers work in conjunction with the roughing mills, which run at constant speed, some speed adjustment is necessary to compensate for difference of draft and variation in roll diameter. The edger motors are equipped with a small amount of series winding so as to obtain a slightly drooping speed characteristic, preventing their overloading should their speed be higher than that of the main mill.

All hot mill stands are driven through reduction gear sets of such ratios as to produce the speeds shown in Table 1.

The addition of two stands to the finishing train makes this mill conform to the conventional layout, and has doubled the maximum slab weight rolled on the mill.

H. E. ROBINSON
VICE PRESIDENT

operated valves, and serve to take up any slack that may be formed between stands.

Screwdowns on all hot mill stands are driven by 230 volt d-c. motors, see Table 2.

In the finishing train, where two screwdown drives are used on each stand, they may be joined together through a magnetic clutch so as to operate both screws in unison if desired.

To insure a good clean surface on the product from the mill, hydraulic descaling sprays are provided at the delivery sides of No. 1 scalebreaker and No. 2 rougher, the entry side of No. 4 rougher, and the delivery side of No. 2 scalebreaker. Water for these sprays is supplied by two horizontal 5¼″ x 18″ double acting triplex plunger pumps, each rated at 850 gpm. at 1000 lb. per sq. in. pressure, and driven by a 600 hp.

A looper is provided at the delivery side of each of the first five finishing stands. They are operated by air cylinders controlled remotely through solenoid

Hot strip 74 inches wide races through the fifth finishing stand, which was transferred from the original roughing line.

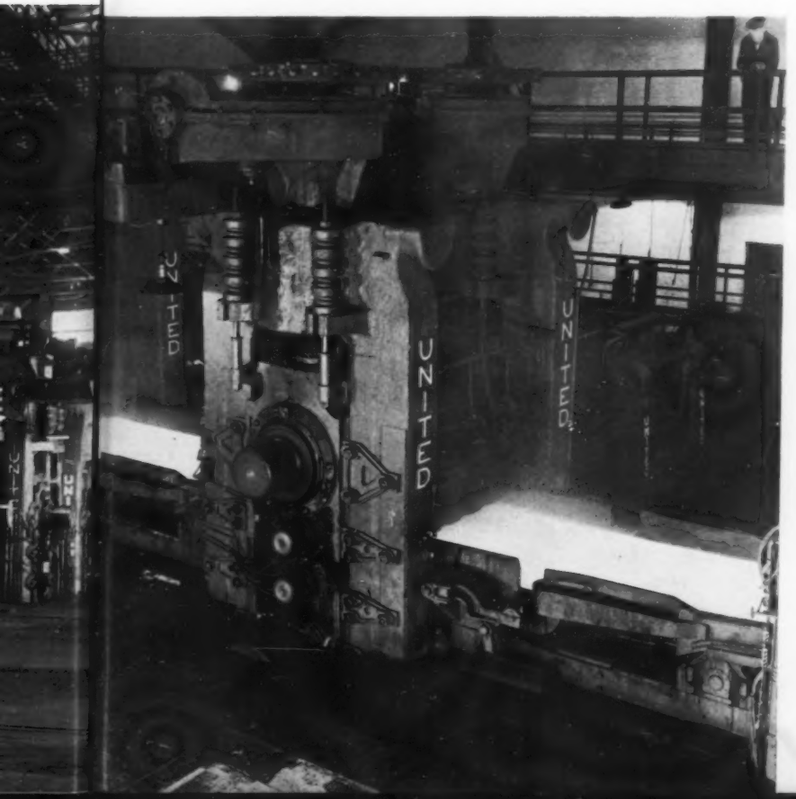
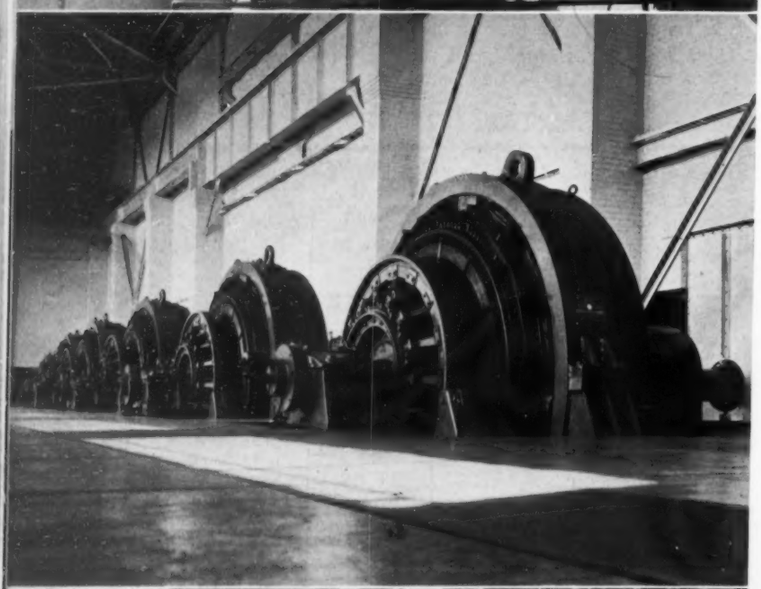


TABLE 1

	Gear Ratio	Roll Speed Rpm. at Full Load	Strip Speed Ft. per Min.
No. 1 Scalebreaker	34.2	14.6	122
No. 1 Rougher	12.3	16.1	137
No. 2 Rougher	26.6	21	173
No. 3 Rougher	7.05	28.1	243
No. 4 Rougher	10.3	34	272
No. 2 Scalebreaker	27.4	11/38	80/280
No. 1 Finisher	5.75	30/60	165/330
No. 2 Finisher	3.42	51/102	280/560
No. 3 Finisher	2.24	78/156	430/860
No. 4 Finisher	1.60	110/220	605/1210
No. 5 Finisher	1.33	131/262	720/1440
No. 6 Finisher	1.32	151/302	830/1660

TABLE 2

No. 1 Scalebreaker	(1)	30 hp. compound.
No. 1 Rougher	(1)	43 hp. series.
No. 2 Rougher	(1)	43 hp. compound.
No. 3 Rougher	(1)	43 hp. series.
No. 4 Rougher	(1)	55 hp. series.
No. 2 Scalebreaker	(2)	15 hp. compound.
No. 1 Finisher	(2)	35 hp. compound.
No. 2 Finisher	(2)	35 hp. compound.
No. 3 Finisher	(2)	35 hp. compound.
No. 4 Finisher	(2)	35 hp. compound.
No. 5 Finisher	(2)	35 hp. compound.
No. 6 Finisher	(2)	35 hp. compound.



synchronous motor. In addition, steam jets are placed at the entry sides of No. 1 and No. 2 roughers.

Bronze bearings are employed on the two-high stands of the hot mill, and roller bearings on both back-up and work rolls of the four-high stands. Both types of bearings are pressure grease lubricated.

From the hot mill, the runout table proceeds for a distance of about 185 ft., where two coilers are located. One of these is a new and wider coiler, which has been equipped with the latest improvements, including a new type of staggered groove rolls, with fingered apron plates registering with the roll grooves, and a modern unloader. The coilers are operated on a variable frequency control system, as are the seventy-two individual table roll drive motors incorporated in the runout table. Hot runout table speed is adjustable in the range of 800-1600 ft. per minute.

Material from the hot mill not intended for coiling is moved transversely from the hot runout table over a hot-bed to a cold run table paralleling the mill. At one end of this table is a gate shear and shear table, and at the other end, a flying shear, roller leveller, and piler. By running the table in either direction, product may be put through either shear as desired. The flying shear may be adjusted at present to cut lengths through a range of 5 to 20 ft., although changes are contemplated

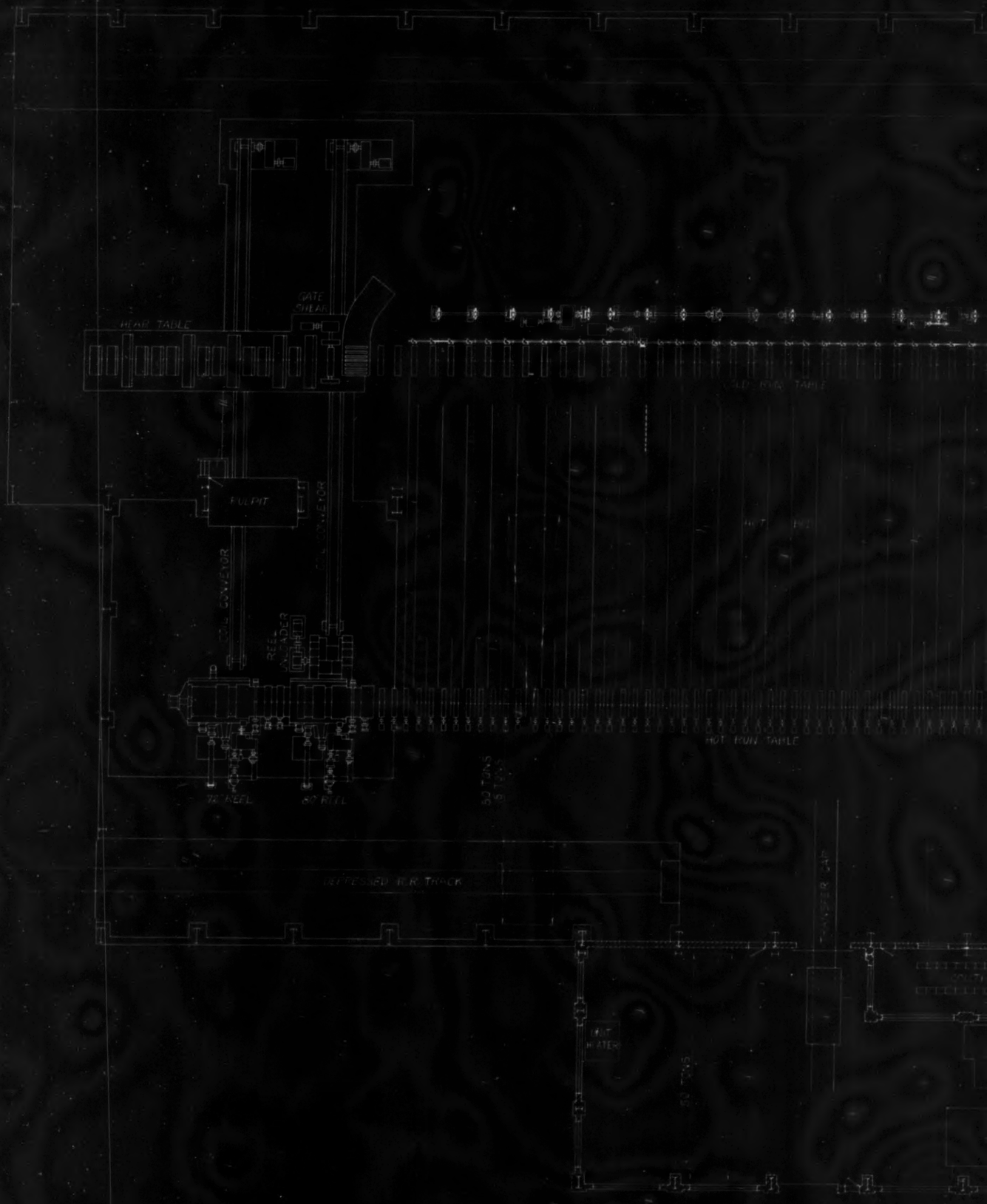
Top—General view of the hot mill motor room, with roughing stand drive motors in foreground. Center—Finishing train drives are all variable speed motors, of 600 volts d.c., shunt wound type. Bottom—These dual motor-generator sets provide d.c. power for the finishing stand motors.

which will permit cutting up to 50 ft. lengths. The shear is driven by a 150 hp., 400/800 rpm., 230 volt d-c. motor with speed regulation obtained through field rheostat adjustment.

Included in the modernization program was the installation of a new hot cutting-up line, composed of an uncoiler, a processor, looping table, shear and gauge, slitter, leveller, and piler. This unit has a maximum speed of 150 ft. per min., and can shear widths up to 72″, in gauges up to 3/16 inches.

ELECTRICAL EQUIPMENT

The hot mill motor-room houses all main hot mill drives except that of the finishing scalebreaker, which is located in the mill building proper. All of the reduction gears are also placed in the mill building, together with the pinion stands. Roughing mill motors are all of slip ring induction type, with resistor control. Finishing mill drives are all 600 volt d-c. regulated as a group by generator voltage control, and are powered from three dual motor-generator sets. Two of these consist of two 2000 kw., 600 volt d-c. generators driven at 514 rpm. by a 5000 kva., 11000 volt, 60 cycle a-c. synchronous motor, while the third is made up of two

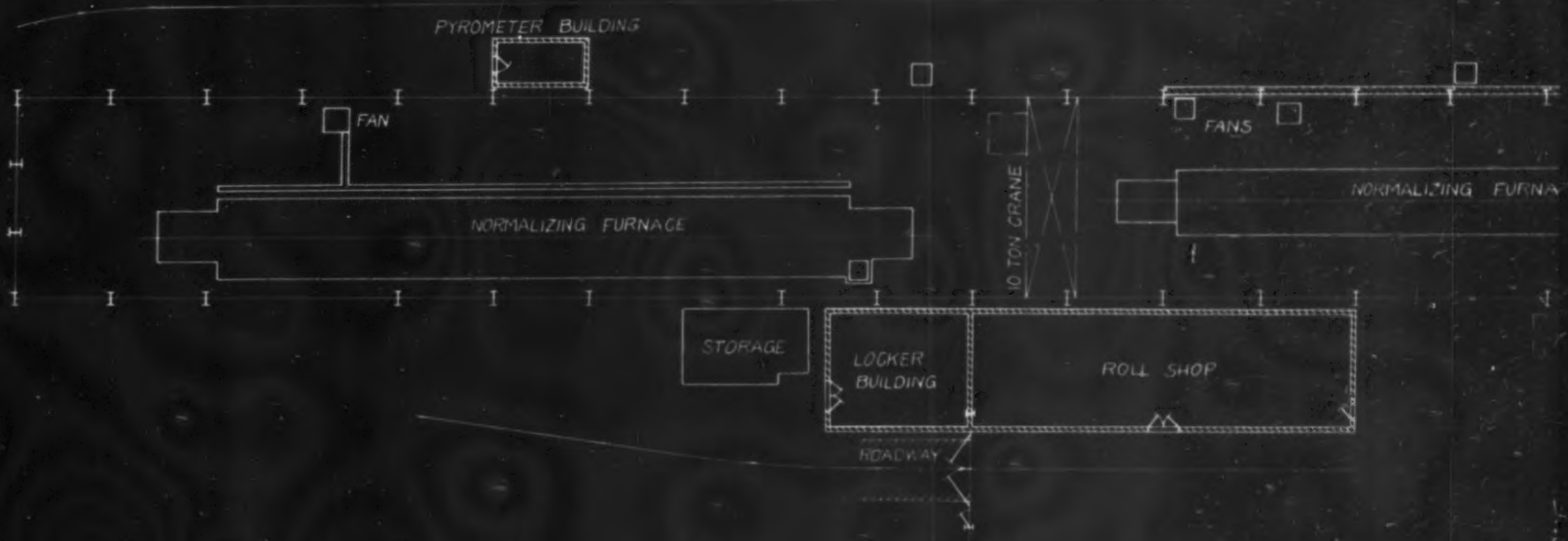

HEAT TABLE
GATE SHEAR
PULPIT
HOT RUN TABLE
HOT RUN TABLE
INTERSTATE R.R. TRACK

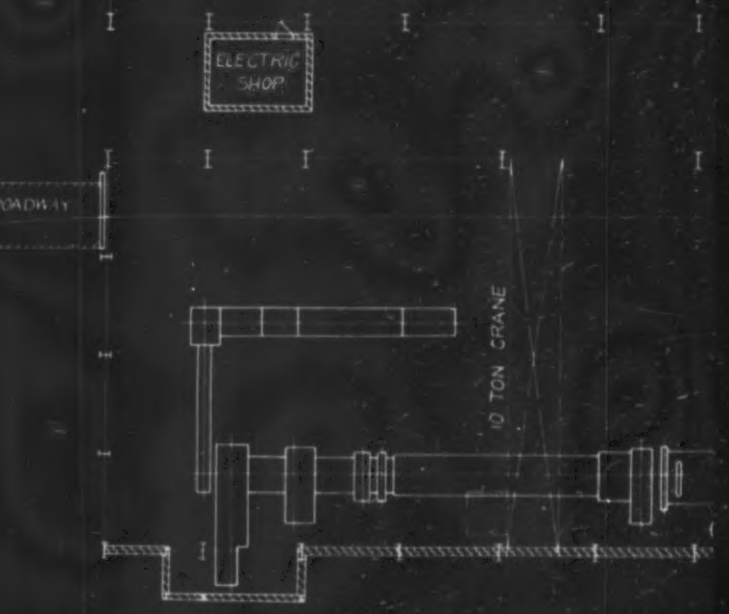
77" CONTINUOUS HOT MILL - OHIO SITE

77" CONTINUOUS HOT MILL - OTIS STE

TIS STEEL COMPANY

FURNACE BURNERS
FUEL OIL TANK
R.R. TRACK
SLAB PILER
PULPIT
FURNACE RUN IN TABLE
SLAB YARD
5 TONS
CONVEYOR
SLAB TRANSFER
SLAB SCALE
800 TON HYDRAULIC SHEAR
SHEAR RUN IN TABLE
TABLE
FURNACE
RUNOUT
TABLE
BUMPER
BUMPER
SLAB PUSHER
CONTROL HOUSE
52 ROLL LATHE
ACCUMULATOR
TANKS
MILL WRIGHTS
OILER ROOM
HYDRAULIC UNITS 56 GPM
0
10
20
30
40
50

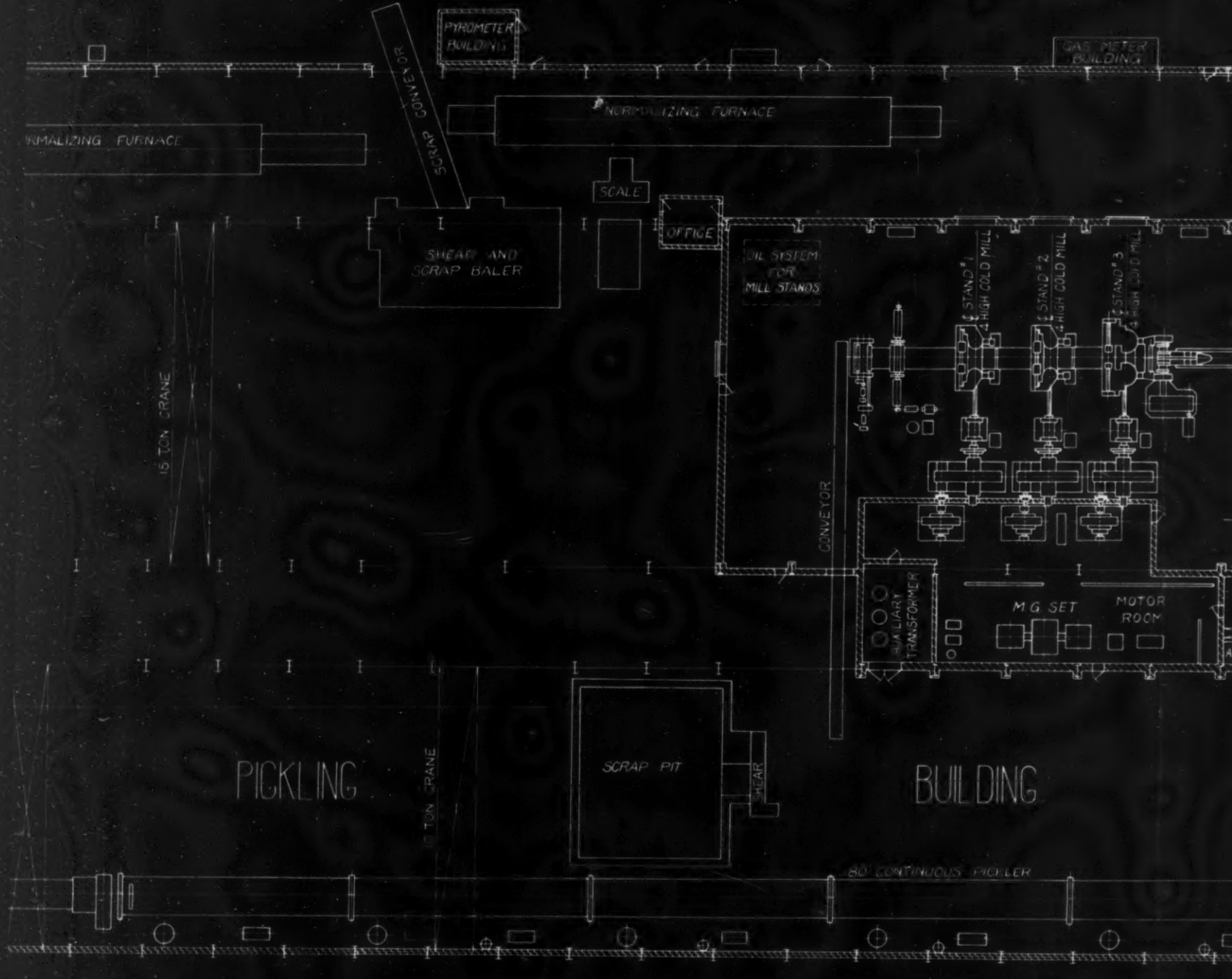

PYROMETER BUILDING
FAN
NORMALIZING FURNACE
10 TON CRANE
FANS
NORMALIZING FURNA
STORAGE
LOCKER BUILDING
ROLL SHOP
ROADWAY


ELECTRIC SHOP
ROADWAY
10 TON CRANE

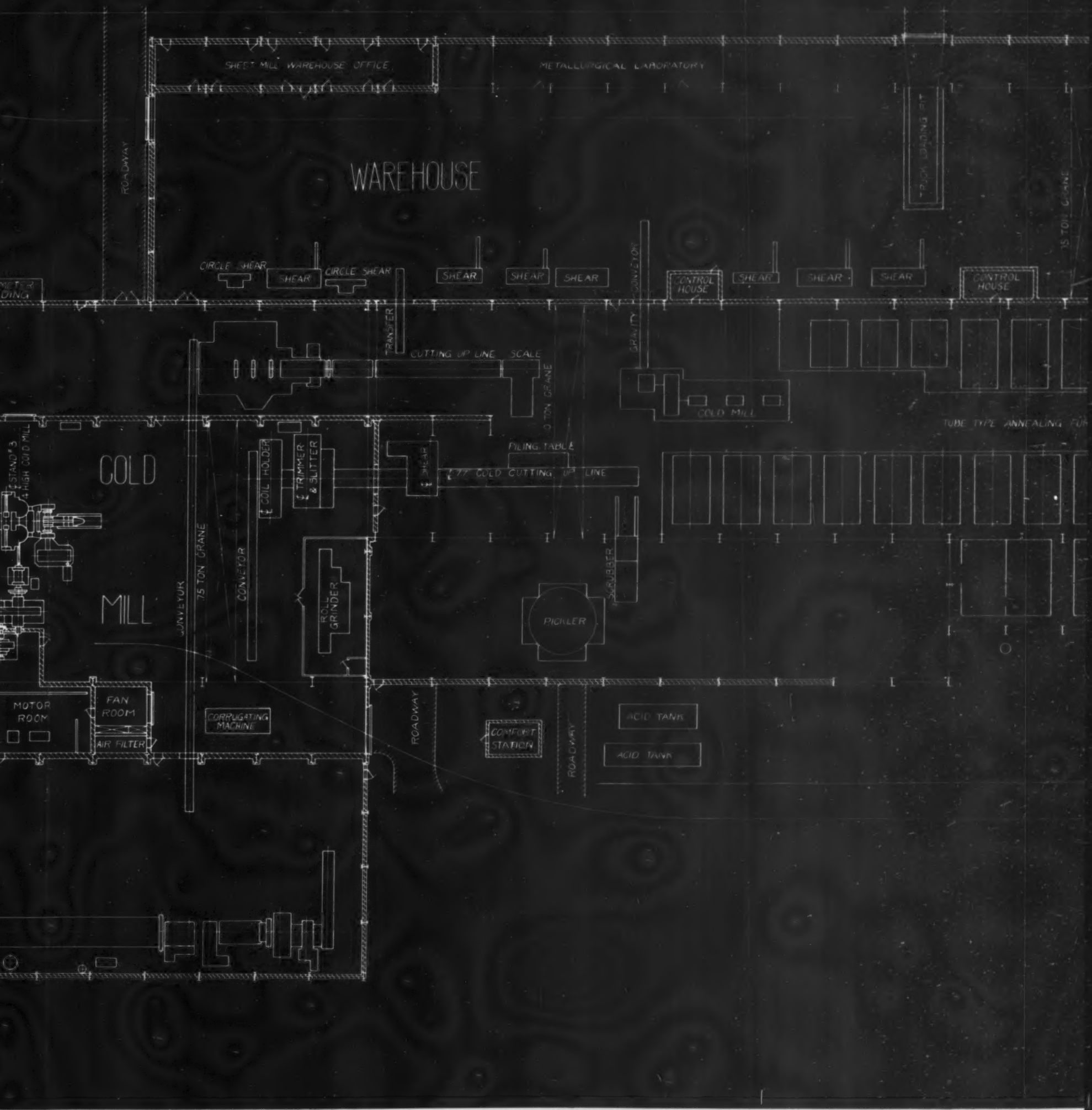
SCALE
0
20
40
60
80
100

WATER VALVE PIT

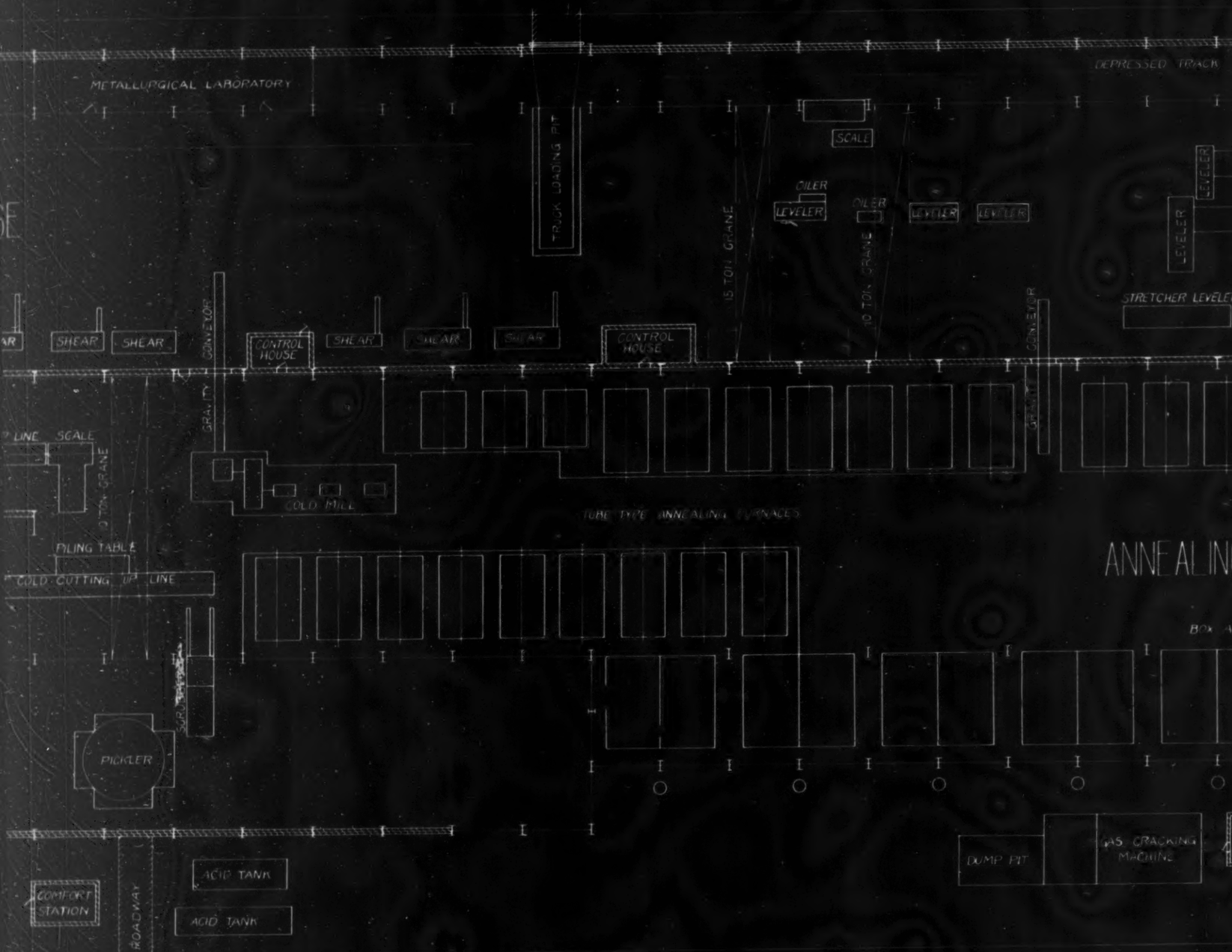
CONTINUOUS COLD STRIP

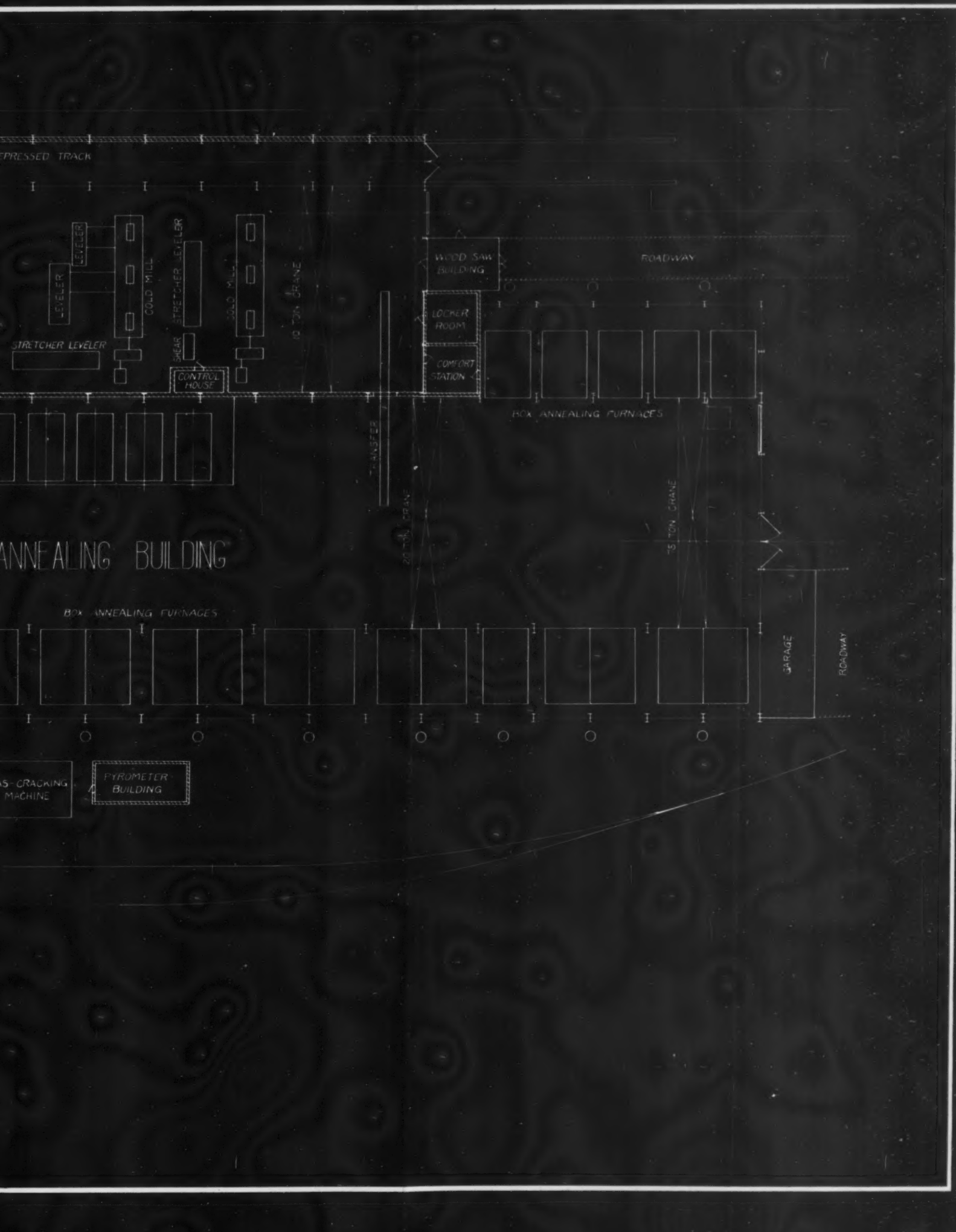


STRIP MILL AND FINISHING DEPARTMENT - OTIS STEEL COMPANY



ARTMENT-OTIS STEEL COMPANY

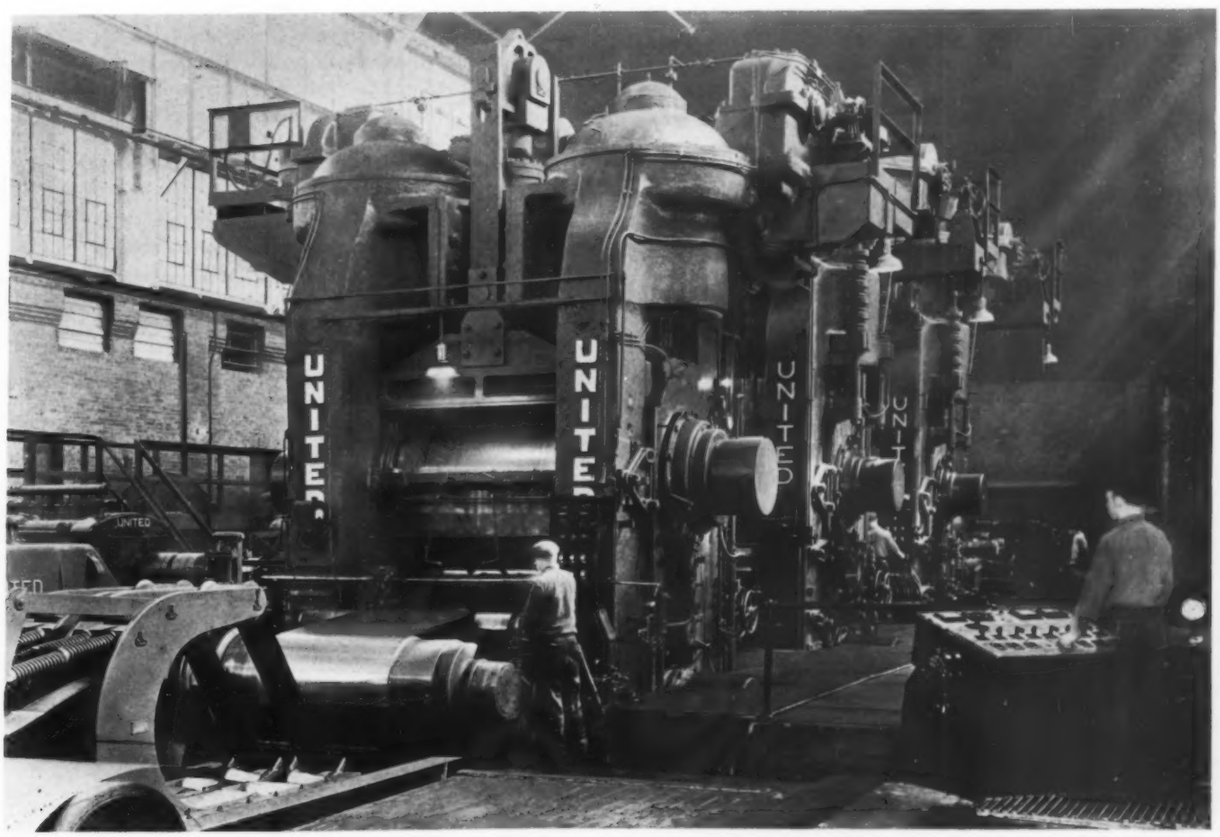



EPRESSED TRACK
LEVELER
LEVELER
COLD MILL
STRETCHER LEVELER
SHEAR
STRETCHER LEVELER
COLD MILL
9 TON CRANE
CONTROL HOUSE
WOOD SAW BUILDING
ROADWAY
LOCKER ROOM
COMFORT STATION
BOX ANNEALING FURNACES
TRANSFER
ANNEALING BUILDING
BOX ANNEALING FURNACES
15 TON CRANE
GARAGE
ROADWAY
S-CRACKING MACHINE
PYROMETER BUILDING

MILL DATA

Stand	Characteristics	Roll Diameter		Roll Length	Motor				Remarks
		Work Roll	Backup Roll		H.P.	Volts	R.P.M. at Full Load	Type	
HOT MILL									
No. 1 Scalebreaker	1-Stand, 2-high.	32″	.....	76″	800	2300	500	Slip ring 60 cycle	Geared. Flywheel.
No. 1 Edger	1-Stand, 2-high.	20″	.....	11″	150	250	600/900	Compound d-c.	Geared.
No. 1 Rougher	1-Stand, 2-high.	32½″	.....	76″	1200	2300	198	Slip ring 25 cycle	Geared. Flywheel.
No. 2 Edger	1-Stand, 2-high.	20″	.....	11″	150	250	600/900	Compound d-c.	Geared.
No. 2 Rougher	1-Stand, 2-high.	33″	.....	76″	1600	2300	560	Slip ring 60 cycle	Geared. Flywheel.
No. 3 Edger	1-Stand, 2-high.	20″	.....	11″	150	250	600/900	Compound d-c.	Geared.
No. 3 Rougher	1-Stand, 2-high.	33″	.....	76″	2000	2300	198	Slip ring 25 cycle	Geared. Flywheel.
No. 4 Rougher	1-Stand, 3-high.	22½″	30½″	77″	3000	6600	350	Slip ring 25 cycle	Geared. Flywheel.
No. 2 Scalebreaker	1-Stand, 2-high.	28″	.....	77″	400	600	300/1050	Shunt d-c.	Geared.
No. 1 Finisher	1-Stand, 4-high.	21″	46⅝″	77″	3500	600	175/350	Shunt d-c.	Geared.
No. 2 Finisher	1-Stand, 4-high.	21″	46⅝	77″	3500	600	175/350	Shunt d-c.	Geared.
No. 3 Finisher	1-Stand, 4-high.	21″	46⅝″	77″	3500	600	175/350	Shunt d-c.	Geared.
No. 4 Finisher	1-Stand, 4-high.	21″	46⅝″	77″	3500	600	175/350	Shunt d-c.	Geared.
No. 5 Finisher	1-Stand, 4-high.	21″	46⅝″	77″	3500	600	175/350	Shunt d-c.	Geared.
No. 6 Finisher	1-Stand, 4-high.	21″	50″	77″	2500	600	200/400	Shunt d-c.	Geared.
COLD MILL									
Tandem Mill	3-Stands, 4-high.	21″	52″	77″	(1) 1250 (2) 1500	600 600	250/612 200/400	Shunt d-c.	Geared.
Reel	.....	.....	.....	...	250	600	300/1350	Shunt d-c.	Geared.

Rolling capacity of the cold mill was doubled by widening and by the addition of the third mill stand.



W. R. ELLIOTT
ASSISTANT TO VICE PRESIDENT
IN CHARGE OF OPERATIONS

R. M. FENTON
CHIEF ENGINEER

F. C. OVIATT
SECRETARY-TREASURER

3000 kw. generators driven at 360 rpm. by a 6500 kva. synchronous motor of the same characteristics. All of these sets use 250 volt separate excitation. The fields of all of the generators are connected in parallel and are controlled as a unit through a motor-operated field rheostat. Separate rheostats are placed in the field circuit of each generator to facilitate load equalization between the machines. The generators are shunt wound and separately excited in order to have stability at low voltage. To correct for the resulting drooping voltage characteristic, a voltage regulator is used to maintain voltage on the bus after it has been built up to full running value.

Variable frequency for runout table and coilers is furnished by three special motor generator sets, all driven by 250 volt d-c. motors. Another M. G. set provides dynamic braking for the coilers and table. Several other small M. G. sets serve battery charging, dynamic braking on the roughers, etc. Auxiliary d-c. power is furnished from a 1500 kw. motor-generator set located in the blooming mill motor-house.

All machines have been fully protected against severe overloads, as well as improper manipulation by the operators. D-c. machines are protected against overspeed. Alarms are sounded should excessive bearing temperatures develop.

Relays, control switches and meters for both a-c. and d-c. machines are mounted on a central vertical board in the motor room. A very complete installation of integrating and recording instruments gives details as to mill and generator performance.

DATA ON OILING SYSTEMS

Number	Type of System	Kind of Oil Used	Storage Capacity (Gallons)	Circulation Capacity (gpm)	Equipment Served
1	Pressure	SAE No. 20	1000	5	Motor bearings.
1	Pressure	SAE No. 20 winter SAE No. 40 summer	2000	20	Reduction gear bearings.
1	Pressure and bath	Extreme Pressure	5000	175	Reduction gears on No. 1–No. 5 finishers.
1	Pressure	Extreme Pressure			Pinion stands on No. 1–No. 5 finishers.
1	Pressure and bath	100–110 SSU Visc.	450	50	Reduction gears on No. 6 finisher.
1	Pressure	110–110 SSU Visc.			Pinion stands on No. 6 finisher.
1	Pressure and bath	100–110 SSU Visc.	450	35	Finishing scalebreaker.
1	Pressure and bath	100–110 SSU Visc.	1000	50	Flying shear.
1	Gravity	SAE Nos. 20 and 40	100		Hydraulic pumps.
1	Pressure and bath	100–110 SSU Visc.	200	12	Screwdown on No. 6 finisher.
1	Pressure	Extreme Pressure	150	50	No. 1 scalebreaker and No. 1 and No. 4 roughers.
1	Pressure	Extreme Pressure	150	50	No. 3 rougher gears.
1	Bath	Extreme Pressure	150		Reduction gears, No. 1 scalebreaker and Nos. 1, 2, and 4 roughers.
1	Pressure	2400 SSU Visc.	4000	80	Oil-flooded bearings on cold mill.
3	Pressure	100–210 SSU Visc.	150	50	Pinion stands on cold mill.

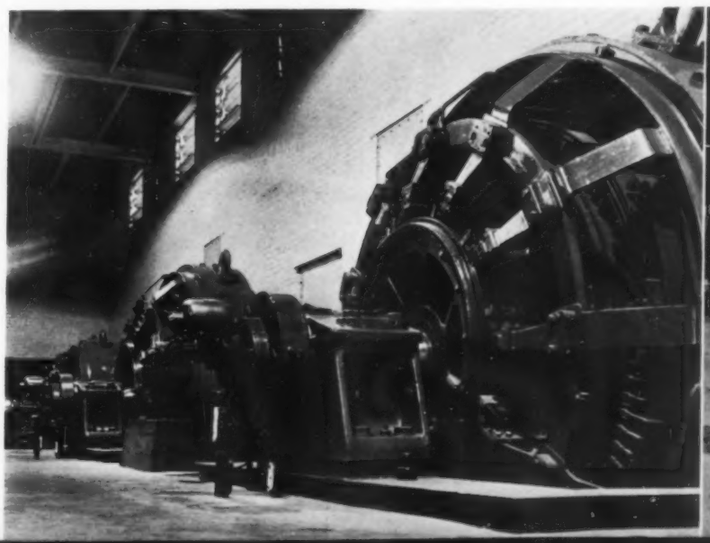
Ventilation for the motor room is provided by three motor-driven fans which draw air from the outside through a battery of air filters.

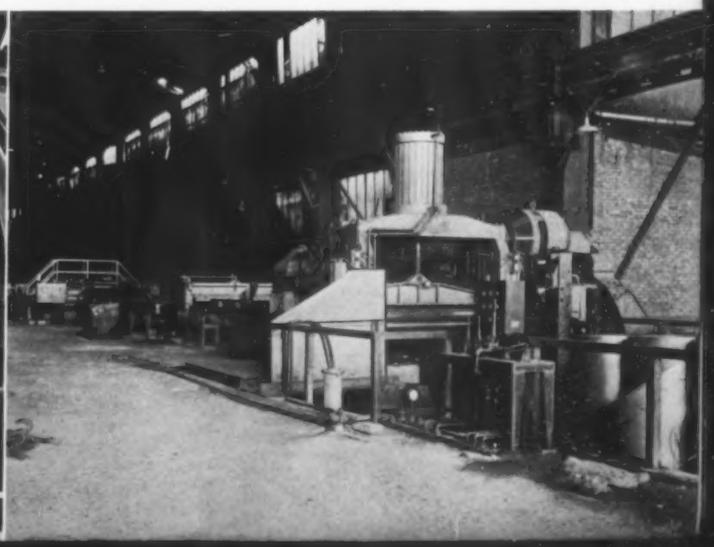
A summary of the rotating electrical machinery used in this mill is as follows:

	Number	Total Hp.
Motors—hot mill	287	55,842
Generators—hot mill	13	20,830
Total hot mill	300	76,672
Motors—cold mill and finishing	41	8,781
Generators—cold mill and finishing	6	3,500
Total cold mill	47	12,281
Grand total	347	88,953

Power for the mill comes from two sources. A connection with the local utility company brings in power at 11000 volts, 60 cycle, while a line from the plant power house carries 6600 volt, 25 cycle power. The finishing motor-generator sets are fed directly from the incoming 11000 volt service, and the drive on No. 4 rougher directly from the incoming 6600 volt line. Smaller motors are fed from transformers. A transformer station located just outside of the motor room houses an 11000/2300 volt, 60 cycle bank of transformers of 5000 kva. capacity, a 6600/2200/220 volt, 25 cycle bank of 3000 kva. capacity, and a 2300/230, 60 cycle auxiliary transformer of 600 kva. capacity. The 25 cycle bank is provided with a double secondary

Left—The cold mill is driven by 600 volt d.c. shunt wound variable speed motors, giving a maximum delivery speed of 600 ft. per minute. Right Decoiler, shear and slitter on new slitting and shear unit, which can handle strip up to $\frac{3}{16}$" thick and 72" wide at a maximum speed of 150 ft. per minute.





winding so as to give 2400 kva. capacity at 2200 volts, and 600 kva. at 220 volts.

Total connected load of the mill, which is divided between the 60 and 25 cycle systems, is as given below:

	K.V.A.
11000/2300 volt, 60 cycle transformer bank.. (This bank feeds No. 1 scalebreaker, No. 2 rougher, and auxiliaries)	5000
2200/220 volt, 25 cycle transformer bank.... (This bank feeds No. 1 and No. 3 roughers and various auxiliaries)	3000
No. 4 Roughing stand (6600 volt, 25 cycle)..	2600
Finishing mill M. G. sets	
2 x 5000 (11000 volts, 60 cycle).....	10000
1 x 6500 (11000 volts, 60 cycle).....	6500
Cold mill M.G. sets (11000 volts, 60 cycle)....	3500
Auxiliary M. G. set for d-c. power (6600 volt, 25 cycle).....	2100
Total primary connected load.....	32700

PICKLING

Pickling facilities are offered by a continuous line 494 ft. overall length. The entire line was widened to handle the new strip widths, and additional tanks installed, in addition to a new processor and looping pit. It was necessary to extend the building 40 ft. to accommodate these features. The line consists of the usual feed reel, processor, stitching unit, pinch rolls and looping pit, followed by five tanks and the drying, shearing and coiling equipment. The tanks are 60 ft. long x 7 ft. wide x 5 ft. deep, and are constructed with concrete shells, which are coated with asphalt and lined with two courses of acid proof brick laid up in an acid-resisting binding. Each tank has a capacity of 11250 gallons. The first three tanks contain a 3–10 per cent solution of sulphuric acid automatically maintained at temperatures of 160–190 degrees F. The fourth tank is a cold water rinse tank and the last contains hot water to facilitate the scrubbing and drying process. Each tank is provided with a steel-plate rubber-lined cover which is vented to the outside through rubber covered piping and exhauster fan.

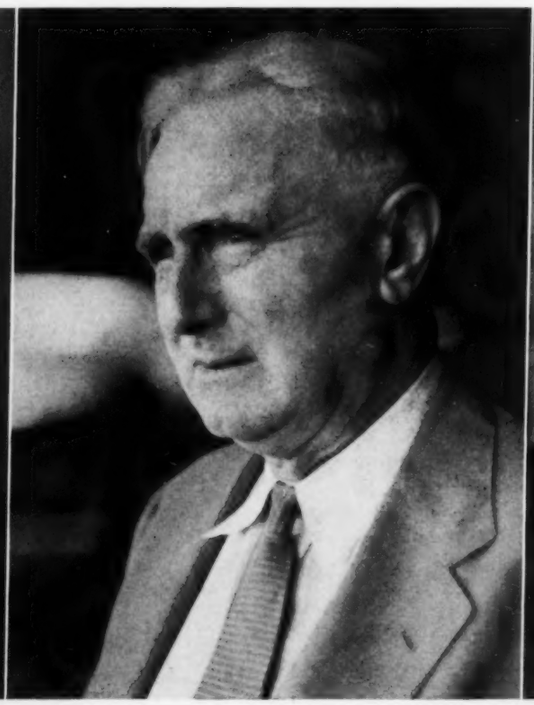
Speed of the strip through the pickling line averages 110–125 ft., and the capacity of the line is approximately 17,000 tons per month.

COLD MILL

In the cold mill, the program of improvement included the installation of a third stand to an existing two-stand tandem mill, thus doubling the speed and permitting the reduction of .109″ hot rolled strip down to No. 20 gauge (.0375″) in a single pass. The mill as it now stands is composed of three 4-high, 21″ and 52″ x 77″ stands, driven by 600 volt d-c. shunt wound motors. One motor is 1250 hp., 250/612 rpm., and two are 1500 hp., 200/400 rpm. units. Gear ratios of these stands are 10.6, 6.95 and 4.3, giving roll speeds

JOHN M. McCOLLOCH
SUPT. SHEET AND COLD STRIP MILLS

JOHN F. SPELLACY
SUPT. 77″ HOT STRIP MILL



J. F. O'MAILIA
ELECTRICAL ENGINEER

of 23.6/57.6, 28.8/57.5, and 46.5/93 rpm., and strip speeds of 130/317, 158/316, and 256/512 ft. per min., respectively. The first two stands are equipped with tapered roller bearings on both work and back-up rolls, while the third stand has oil flooded bearings on the back-up rolls and roller bearings on the work rolls.

The cold mill will handle widths ranging 27″ to 73″, and finished gauges of .022″ to .165″. Gauge is maintained by means of a flying micrometer, and checked with hand micrometers. The mill has a capacity of about 20,000 tons per month. The usual reduction in cold rolling is 55 to 65 per cent.

A belt wrapper installed on the tandem mill affords a means of starting the strip on the recoiling reels. The reel is driven by a 250 hp., 600 volt, 300/1350 rpm. shunt wound motor.

Electrical conduits to this mill were re-routed and the entire control scheme modernized, with a new generator secondary panel, new reel control panel and tension regulator. Dynamic braking has been provided to insure quick stopping of main drive motors.

A new cold shear line, composed of uncoiler, slitter, flying shear and piler, was also installed, capable of cutting stock up to 3/16″ thick in widths up to 72″, at a maximum speed of 200 ft. per minute.

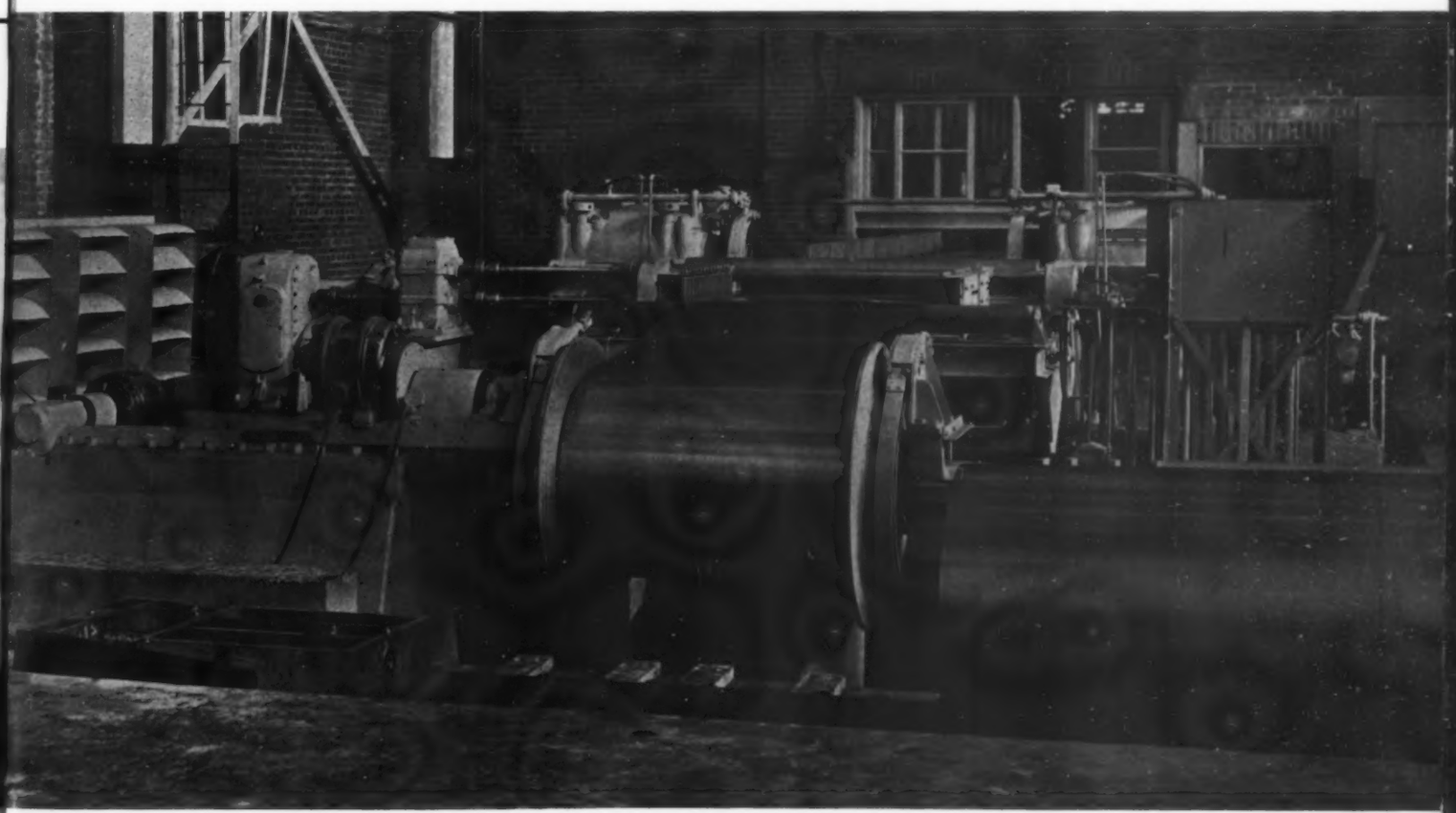
ANNEALING AND NORMALIZING

Before the modernization program, annealing equipment consisted of thirty-seven in-and-out box annealers, fired with powdered coal. To this have been added ten annealing covers heated by vertical radiant tubes. These are fired with natural gas, and show a heat consumption of about 1,200,000 Btu. per ton. There are three bases provided for each cover. Annealing capacity totals about 21,000 tons per month. Deoxidizing atmospheres for the annealing process are supplied from three gas-cracking units, two of 8000 cu. ft. and one of 10,000 cu. ft. per hour capacity.

Normalizing is effected in three continuous furnaces with roller hearth conveyors. Sheets up to 70″ x 54″ may be accommodated. The furnaces are made up of a 70 ft. heating zone, a 32 ft. cooling zone, and a 7 ft. water cooled arch. They are fired with natural gas, consuming about 5,000,000 Btu. per ton. Speed of travel through the furnace averages about 25½ ft. per minute. Capacity of the department totals about 350 tons per day.

MISCELLANEOUS

Hot mill rolls are cared for in a roll shop located at one end of the hot mill motor room, and containing one 30″ x 168″ and one 52″ x 216″ roll grinder. A new



Cold strip up to 3/16″ thick and 72″ wide may be cut on this new unit at speeds up to 200 ft. per minute.

BUILDING AND CRANE DATA

Building	Length	Width	Cranes		
			Number	Capacity	Span
Hot mill building	600	86	2	50/15	85′–8″
			1	25/10	95′–4″
Hot mill motor room	400	50	1	25	50′–0″
Hot mill roll shop	120	50	1	50/10	50′–0″
Cold mill building	228	90	1	75/25	86′–0″
Hot shear line	200	115	1	15	56′–0″
			1	15	111′–0″
Cold shear line	100	80	1	75/25	86′–0″
			1	10	75′–9½″
Sheet annealing	620	80	1	75/15	75′–9½″
			1	20	75′–9½″
			1	10	75′–9½″
Normalizing department	456	40	1	10	36′–7″
Pickling department	494	75	2	10	71′–7″

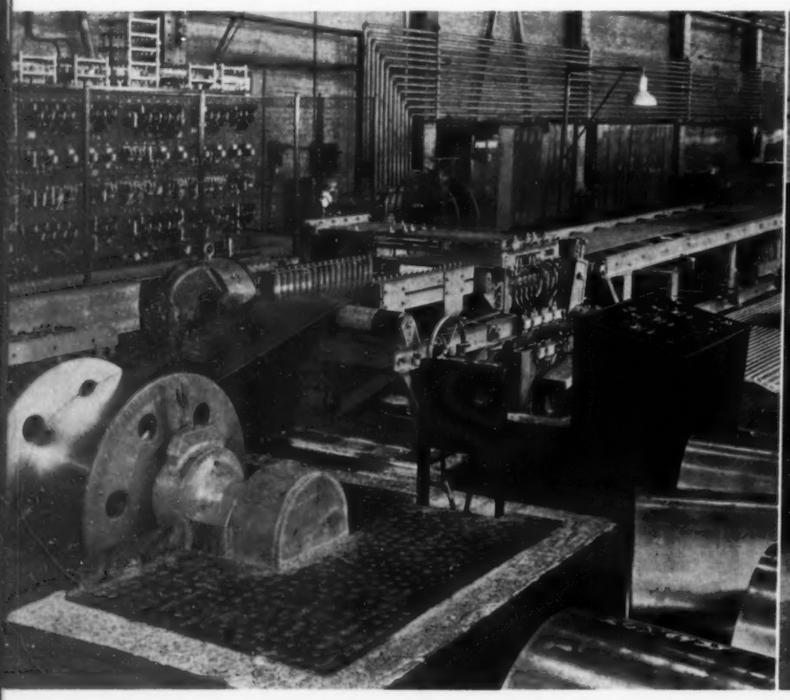
24″ x 168″ roll grinder was also installed in a special roll shop located at the cold mill.

Steam requirements of the strip mill are taken care of from the waste heat boilers at the open hearth plant, and amount to about 2,000,000 lb. of steam per month.

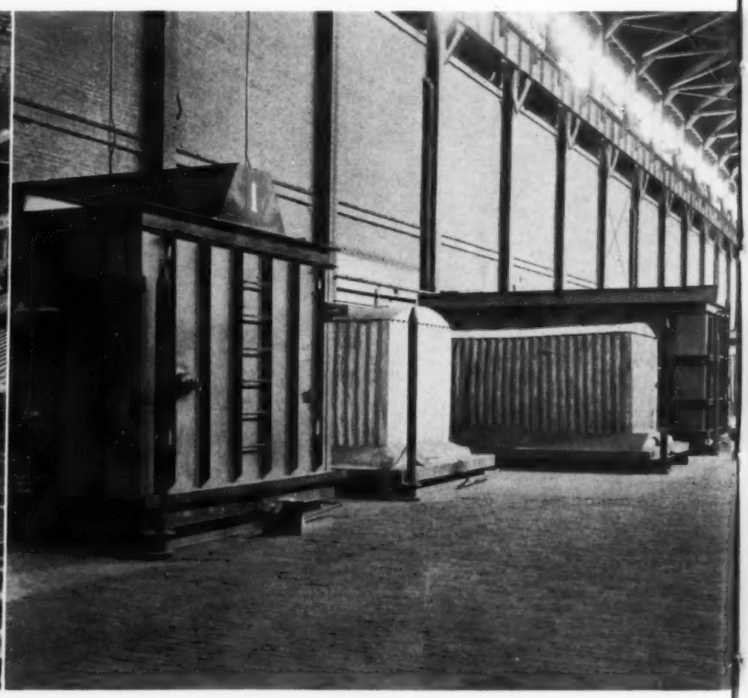
Water is taken from the Cuyahoga River at a rate of approximately 5500 gallons per minute.

The buildings going to make up the strip mill, together with their crane provisions, are tabulated above.

Another new shearing line installed in conjunction with the recent modernization program.



Product is annealed in radiant tube type annealing furnaces which have one cover for each three bases.



HYDRAULIC *Descaling* SYSTEM *for* REPUBLIC STEEL CORP'S. NEW 98" *Strip* MILL

By JAMES M. MAIN, Engineer

REPUBLIC STEEL CORP.

CLEVELAND, OHIO

▲ A MAJOR requirement of finished steel sheets for present day markets is a surface finish of the finest quality free from all imperfections and irregularities.

One of the most important factors in obtaining this required high quality finish is the complete removal of all scale from the heated slab, thus preventing scale and foreign material from being rolled into the surface of the finished steel.

Complete removal of all scale is obtained by directing high velocity water jets against the slabs at the proper locations on the continuous mill, the jets removing the scale through the cracking effect due to differences in temperatures as well as by the impinging force of the jets themselves.

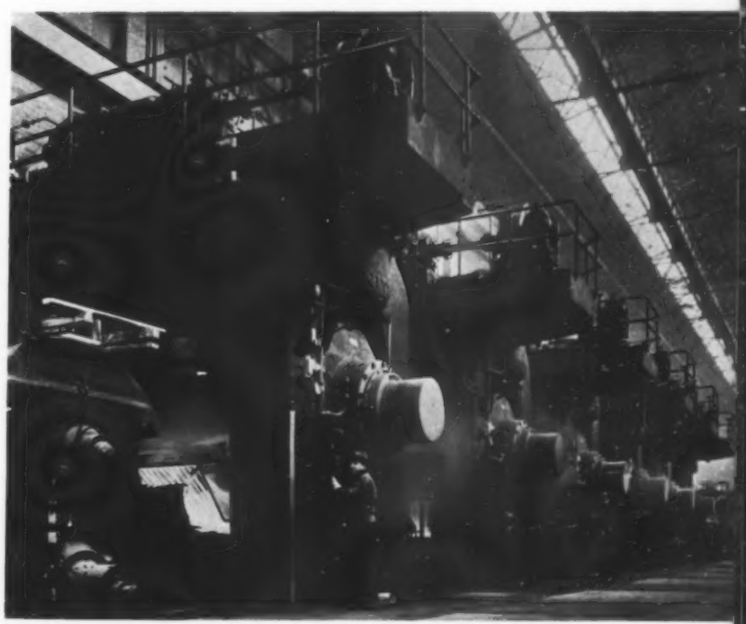
In the design of the hydraulic descaling system for Republic's 98-inch strip mill, every effort was made to provide a descaling system which would produce strip of highest quality, have a reasonable pumpage cost and a minimum maintenance cost, and which would present a minimum operating hazard. At every point in the selection of pressures, location of sprays, and selection and location of equipment, these were the determining factors.

In reviewing the operating results of various other descaling systems, one of the major sources of trouble was found to be due to water hammer. The complexity of any mathematical analysis of disturbances of this nature, in light of the many variables involved, made it desirable to solve the problem by more practical methods. To this end it was decided to set a maximum velocity of 24 feet per second in any portion of the high pressure piping system and at the same time avoid any abrupt changes in the direction of flow in the vicinities of high velocity.

In order to reduce to a minimum the hydraulic shock on the pumps and at the same time conserve power, it was decided to provide a hydro-pneumatic accumulator in the line. The decision to use an accumulator in the line was made despite the difficulties involved in operating this type of equipment, particularly in regards to the control apparatus necessary.

As an additional protection against surges on the suction side of the pumps, a filtered water tank of 13,000 gallons capacity with a surge pipe was provided as a means of alleviating shocks and to provide a suffi-

Hydraulic sprays serve to remove scale from the strip after passage through the scalebreaker.



cient amount of filtered water, close to the pumps, for sudden demands.

The pressure determined upon after extensive consideration was 1200 pounds per square inch at the pump discharge. This pressure, it was felt, would be sufficient to produce the desired quality of surface and, with few exceptions, would be within the range of safe pressures possible with piping materials and equipment of standard manufacture.

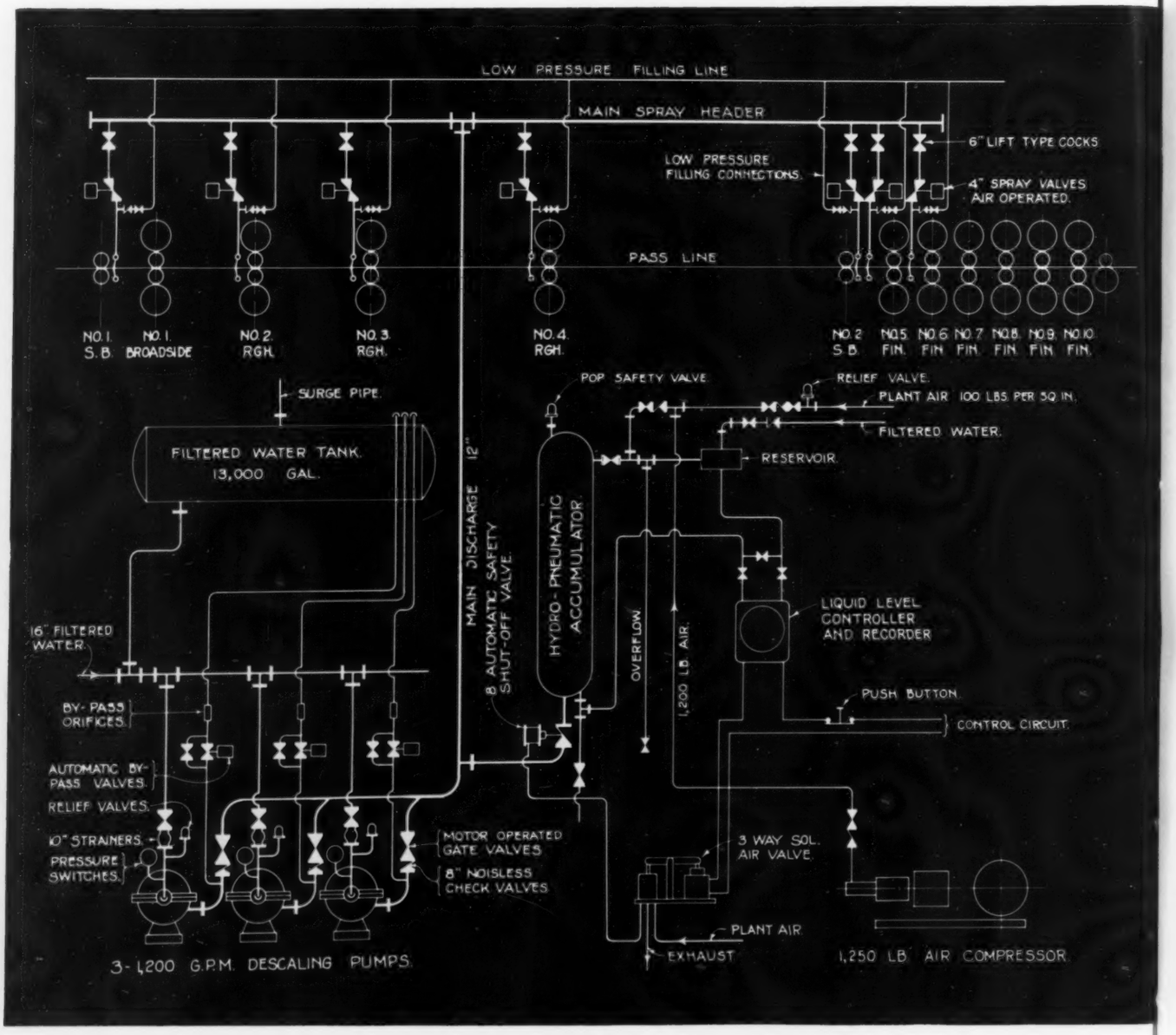
From the above pressure assumption, analysis was made of the water demand based on various rolling schedules, and then the number, size and location of the spray nozzles was determined. It was decided to locate the descaling points as follows (see Figure I):

Delivery Side—No. 1 Scale Breaker
Entry Side —No. 2 Rougher
Entry Side —No. 3 Rougher
Entry Side —No. 4 Rougher
Delivery Side—No. 2 Scale Breaker
Delivery Side—No. 5 Finishing Stand

Sprays on the No. 1 Scale Breaker consist of six special 1 inch Republic Steel Corporation nozzles, spaced on 8 inch centers and located a maximum distance of 17½ inches above the top of the slab, and ten ½ x 1/16 inch nozzles spaced on 4½ inch centers and located 9½ inches below the bottom of the slab.

Sprays on the No. 2, 3 and 4 Roughing Stands consist of sixteen ½ x 1/16 inch spray nozzles spaced on 6 inch centers and located 12 inches above and below the slab. The axis of spray is inclined at an angle of about 15 degrees against the direction of flow of the slab. Some deviation from the above was necessary in the actual installation on account of interference with entry guides and other mechanisms on the various stands.

A diagrammatic lay-out of the entire hydraulic descaling system is given below.



Sprays on the No. 2 Scale Breaker consist of a double battery of twenty ½ x 1/16 inch nozzles, spaced on 4⅞ inch centers and located 9¾ inches above and below the slab. Like the others, these sprays are inclined at an angle of about 15 degrees against the direction of flow.

Sprays on the No. 5 Finishing Stand have not been found necessary at the present time, but provision has been made for their installation should they be required.

The end nozzles on each row of sprays on all stands are of the capped type which make it possible to close these nozzles when narrow width strip is being rolled, thus eliminating unnecessary pumpage.

The maximum peak demand was found to be about 2,500 G.P.M. and the maximum average demand about 1,500 G.P.M. when rolling 94 inch wide.

Because of their ability to supply a widely flexible demand and because of their low upkeep cost, it was decided to use centrifugal pumps. Three such pumps were used, each of 1,200 G.P.M. capacity, providing ample pumping equipment at all times with one pump as a stand-by.

The pumping equipment consists of three units, each consisting of one two-stage low pressure booster pump connected to a seven-stage high pressure centrifugal pump. Each combined unit is connected through a flexible coupling to a 1,200 H.P., 1,800 R.P.M., 3 phase, 60 cycle, 2,300 volt induction motor. The entire unit is mounted on a common sub-base. Advantages obtained by this arrangement are elimination of a longer shaft, and less expensive construction, the casing of the booster pump being cast iron. The high pressure pump has a steel casing and solid diaphragms. Running end thrust is provided for by means of a specially designed balancing disc. The combined unit has a normal rating of 1,200 G.P.M. against a total head of 1,200 lbs. per sq. in.

The pump control circuit is interlocked with the control of the motor-operated gate valve in the discharge line from each pump, and functions to prevent starting of the pump unless the gate valve is open. This control also closes the gate valve when the pump current is off.

As additional emergency protection, a trip on the oil circuit breaker is interlocked with the pressure switch on the pump suction and a temperature switch on the balance pipe of the pump. The former functions to open the circuit breaker in case the suction pressure decreases below an established minimum and the latter opens the circuit breaker when there is an increase in temperature above a predetermined point in the balance pipe.

Each pump is also provided with an automatic by-pass consisting of a 1½ inch automatic air pilot operated by-pass valve, a by-pass orifice, and necessary piping to discharge the by-pass back to the filtered water tank.

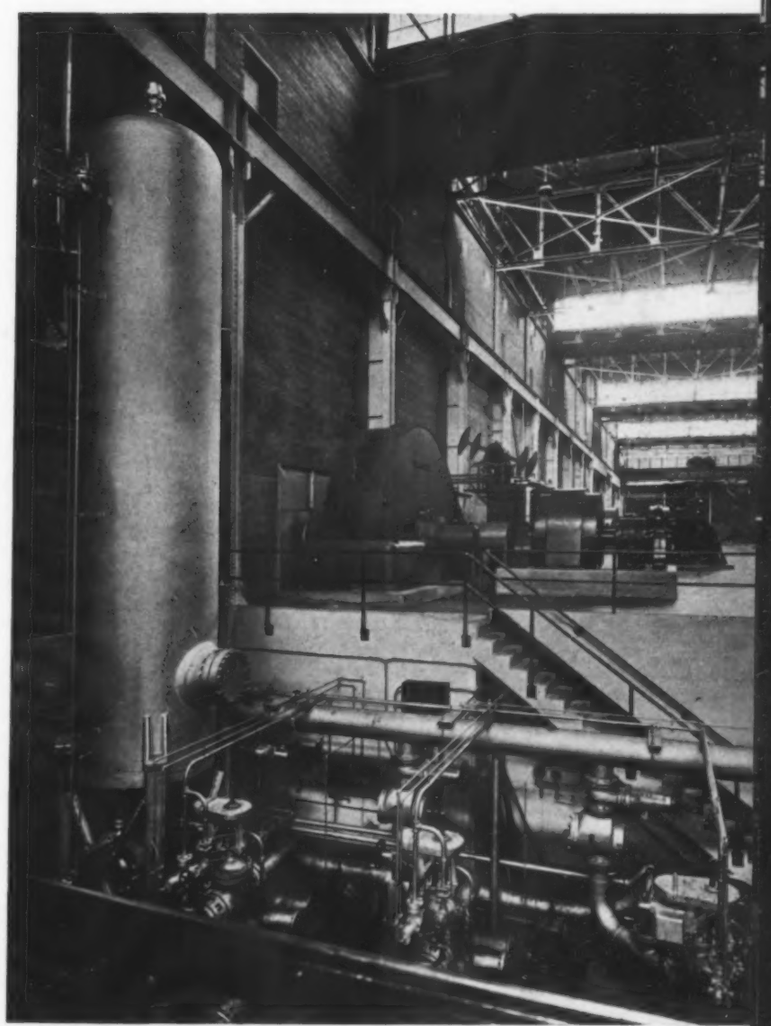
The control for the by-pass valves consists of a current relay in the main pump circuit with a time relay. This functions through a solenoid operated air valve to open the by-pass valve when the motor current decreases to a predetermined point corresponding to the shut-off load on the pumps.

The hydro-pneumatic accumulator, 59 inches I. D. by 28′–11″ over heads, has a total volume of 520 cu. ft. It is located in the descaling pump pit in the motor room and connected through an 8 inch automatic safety shut-off valve directly to the 12 inch main discharge line from the descaling pumps. This connection is made as close as possible to avoid any unnecessary friction drop between accumulator and header.

The accumulator was fabricated for a working pressure of 1,500 lbs. per sq. in. according to the A.S.M.E. and State of Ohio codes for unfired pressure vessels. The shell is 4 inches thick, the elliptical heads $3\frac{19}{32}$ inches thick of A.S.T.M.-A-150 steel with a minimum tensile strength of 70,000 lbs. per sq. in. The vessel was completely X-rayed, stress relieved and subjected to a hydrostatic test of 3,000 lbs. per sq. in.

There were approximately 75 linear feet of longitudinal seams and 33 feet of girth seams all welded on automatic arc welding machines with a depositing rate of 3½ pounds per hour. Each longitudinal and girth seam was deposited in one continuous operation without

The welded steel hydro-pneumatic accumulator reduces hydraulic shock in the descaling system.



interruption. The weight of weld metal deposited amounts to about 3,400 pounds and the total weight of the complete vessel is 87,500 pounds.

Under normal operating conditions, corresponding to a pressure of 1,200 lbs. per sq. in., the vessel will contain about one-third water (1,345 gallons) and two-thirds air. Under the normal variations in demand on the system and accompanying pressure changes, the water capacity will vary from 1,700 gallons to 660 gallons with corresponding pressures of 1,440 to 900 lbs. per sq. in. At a minimum water capacity of 375 gallons and pressure of 800 lbs. per sq. in. the automatic safety shut-off valve closes, preventing further flow from the accumulator to the discharge line.

For supplying air at 1,200 lbs. per sq. in. pressure above the water in the accumulator, and replacing that lost by absorption and other causes, a 100 cu. ft. 3-stage air compressor with inter- and after-coolers is provided for a maximum pressure of 1,250 lbs. per sq. in. The compressor is connected through a V-belt drive to a 50 H.P., 1,200 R.P.M., 3 phase, 60 cycle, 440 volt motor. Due to the normal variation in pressure in the accumulator, automatic control of the compressor was impractical. Manual push button control was provided.

To prevent loss of air from the accumulator in case of pump failure or break in the hydraulic descaling lines, an 8 inch automatic accumulator safety shut-off valve with necessary control was provided.

This valve is essentially a spring-loaded, cushioned check valve with a double sealed seat, normally held in an open position by an air cylinder. Closing of the valve is effected by unbalanced pressure across the seat.

The control for the accumulator safety shut-off valve consists of a special liquid level controller and recorder, with a range of 18 feet. The high level contact is arranged to close the signal light circuit and the low level contact arranged to open the circuit on a solenoid air valve and close the signal light circuit. A three way single solenoid air operating valve is normally in "on" position with solenoid energized.

The operation of the control is as follows: When the level in the accumulator drops below a minimum safe level, the recorder low level contact opens, de-energizing the solenoid on the air valve, thus releasing pressure from the cylinder and allowing the safety shut-off valve to close. When conditions causing closure are corrected by increasing the pressure below the shut-off valve, the flow reverses through the valve into the accumulator. As the level in the accumulator rises, the low level contact closes, energizing the solenoid air valve and building up pressure against the piston to hold the valve in an open position.

The system functions to close the valve under all of the following conditions:

Low water level in the accumulator.
Break in the hydraulic lines.
Pump failure.
Air failure.
Electric circuit failure.

All high pressure water piping was designed for a working pressure of 1,500 lbs. per sq. in. The 12 inch pipe has 1.00 inch wall thickness, the 10 inch pipe .843 wall, and 8 inch pipe and under is double extra strong. All flanges were Series 90, forged steel welding neck flanges with plain raised serrated face. Annealed copper gaskets ⅛ inch thick with alloy steel studs and carbon steel nuts were used.

All fittings were double extra heavy welding fittings Series 90, cast steel flanged or were fabricated by welding.

A recording pressure gauge is provided in the pump room and two indicating gauges are located in the hot mill.

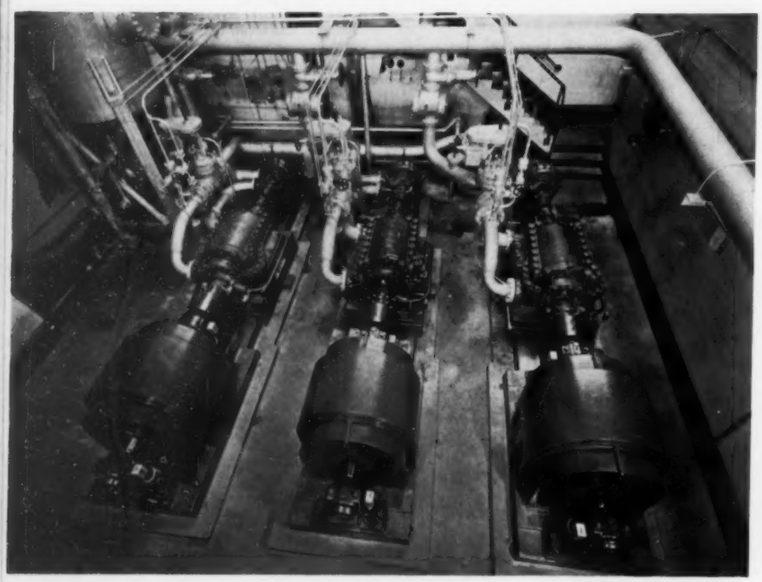
At each spray a 6 inch connection with a 6 inch "straight away" lift-type cock at the main header is provided for shut-off. Below this connection a 4 inch balanced piston-type air-pilot-operated spray valve is located. The operating characteristics of this type of valve eliminates shock in the lines, as the closing time may be regulated as desired, giving a uniform acceleration or deceleration through the valve. From the spray valves a 6 inch double extra heavy line runs to the stands, this line dividing into two 4 inch double extra heavy lines going to the top and the bottom spray headers.

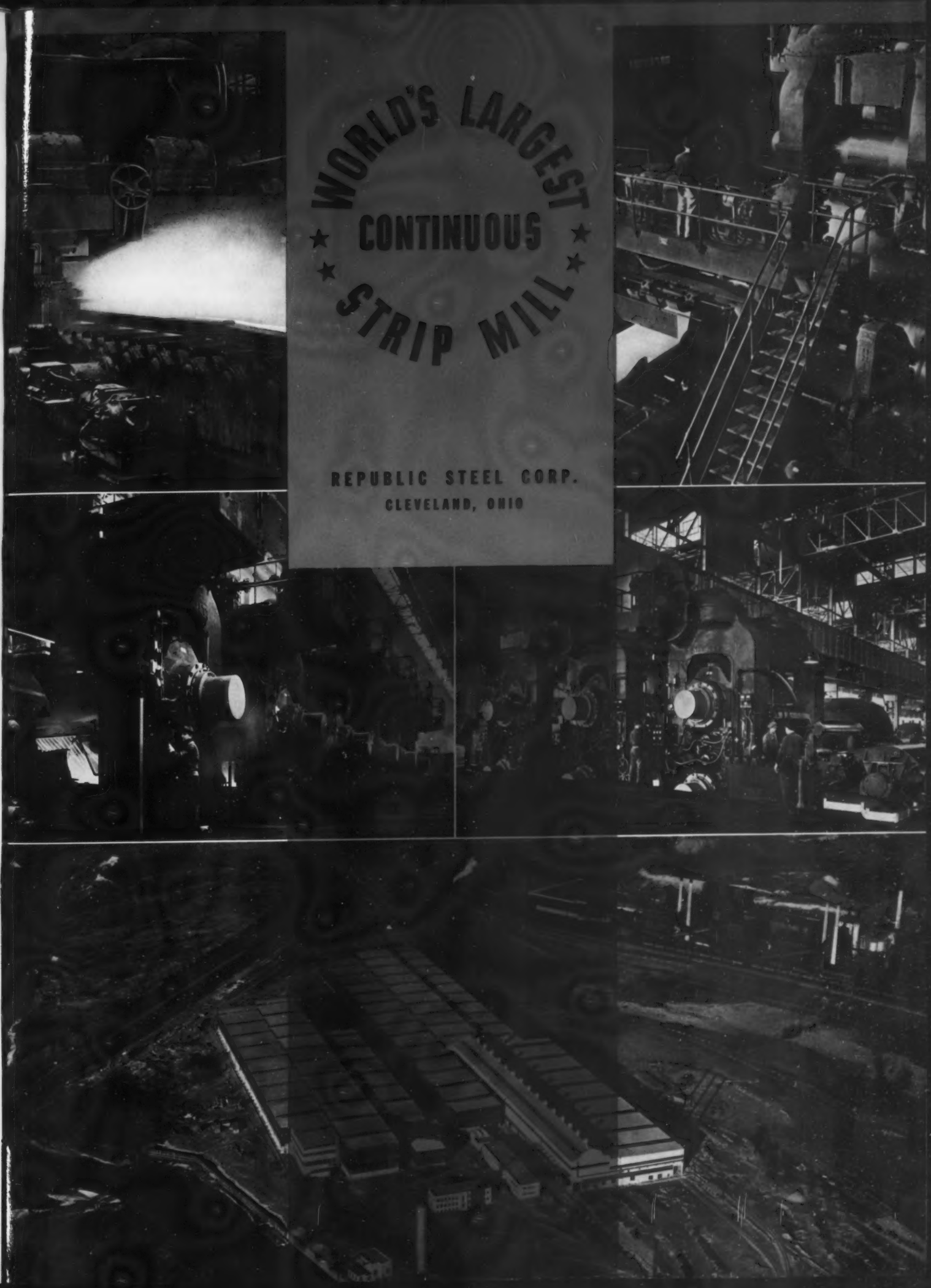
The spray valves are controlled manually in the pulpits or through flag switches located on the tables and operating through solenoid four way air valves located close to the spray valve.

A low pressure filtered water filling connection is made below the spray valves to keep piping and spray headers beyond the spray valve full of water between spraying periods. All high pressure piping and valves are securely anchored to prevent vibration. All piping was fabricated by arc welding.

A 16 inch filtered water suction line from the filter plant supplies the water for descaling. Floating on this line is a 13,000 gallon filtered water tank with surge pipe and overflow. A 10 inch suction connection with a 10-gate valve and basket-type strainer for protection of pumps is provided at each pump. In addition, a low pressure relief valve is provided to protect the low pressure pump casing and piping against excess pressure in case of leaking valves when the pump is down.

The three 1200 G. P. M. multi-stage centrifugal pumps, which comprise the pumping equipment, are located in a pit in the hot mill motor room.




WORLD'S LARGEST
CONTINUOUS
STRIP MILL
REPUBLIC STEEL CORP.
CLEVELAND, OHIO

Republic

Steel Corp's. New 98" CONTINUOUS HOT and COLD Strip Mill CLEVELAND, OHIO

▲ SIX miles south of the mouth of the Cuyahoga River, on a tract of 182 acres formerly given over to swamp and river bed, stands a recent and important addition to the nation's steel producing facilities—the 98″ hot and cold strip mill of Republic Steel Corporation, rated as the largest and fastest in the world, with a nominal capacity of 70,000 gross tons per month, and a maximum hot mill delivery speed of 2121 ft. per minute. The mill is designed to produce widths from 30″ to 94″, and all finished thicknesses from No. 18 gauge strip to ½″ plate.

The construction of this plant entailed a considerable problem due to the fact that it was necessary that the course of the Cuyahoga River be changed for a distance of almost half-a-mile, requiring the moving of over 1,000,000 cu. yds. of dirt to establish a new channel and to fill in the old channel and an adjacent swamp. Into this new fill over 19,000 piles, averaging about 40 ft. in length, were driven, and topped by 120,000 cu. yds. of concrete to form adequate foundations for buildings and equipment. About 15,000 tons of structural steel were used in the construction of the buildings, which cover a total area of about 21 acres. Dimensions of the various buildings included in this plant, together with crane data, are as follows:

	Building		Cranes		
	Length	Width	Number	Capacity Tons	Approx. Span
Slab yard	736′	105′	2	25	100′
Motor room	576′	65′	1	50/10	60′
Hot mill building	736′	85′	2	75/20	80′
Hot mill runout building	960	105′	2	10	100′
			1	15	100′
Plate finishing building	960	105′	3	15	100′
Pickler and storage bldg.	1344′	105′	2	15	100′
			1	10	100′
Box anneal building	624′	105′	2	35/10	100′
Cold mill and roll shop	1056′	105′	1	60/20	100′
			2	10	100′
Cold mill and shipping	864′	105′	3	10	100′
Cold mill motor room	120′	83′	1	25	78′
Machine shop	144′	63′	1	10	58′
Pump house	43′	33′–4″	1	10	29′–4″
Pump house	50′	34′–9″	1	5	31′–9″
Scale basin	176′–6″	19′–6″	1	5	17′

In spite of various difficulties, including a twice-flooded site due to high water of the Cuyahoga River, good time was made in the construction, the first slab being rolled ten months and eight days after construction had been started.

SLAB SUPPLY

To supply slabs for the new strip mill, a new 44″ blooming mill was installed in the nearby Corrigan-McKinney plant, in place of an old 40″ mill. The new bloomer is of conventional two-high reversing type, with rolls 96″ long x 39″ in diameter running in water-lubricated composition bearings. The mill is driven by the 12,000 hp. steam engine used on the old mill. Existing mill pinions were also used. Side guards and manipulator are hydraulically actuated through racks and pinions.

The mill is served by nine blocks of soaking pits,

In the slab yard, which affords ample storage for stock slabs, handling is entirely by cranes.

TOM M. GIRDLER
CHAIRMAN OF THE BOARD

totaling thirty-five holes, all fired with coke oven gas. Seven blocks are regenerative, with two of recuperative type. Dimensions of the pits are as follows:

Eight holes—12′–0″ x 5′–6″ x 9′–0″.
Twenty holes—12′–0″ x 5′–6″ x 8′–0″.
Seven holes—13′–8″ x 6′–0″ x 10′–2″.

Slabs from the 44″ blooming mill are moved to an adjacent slab storage building 623 ft. long by 98 ft. wide, where they are prepared for subsequent rolling in the strip mill. Cleaning is largely done by the scarfing process. Transportation from this storage to the slab yard of the strip mill is effected by rail. At the strip mill, cars are unloaded by slab yard cranes equipped with lifting magnets. Cranes again handle slabs to the heating furnaces, each of which is supplied with a hydraulically operated depiler, in place of the more usual single magazine feeder with charging table running across the back ends of the furnaces. Each furnace is also equipped with a double ram type pusher, electrically driven through rack and pinion, so that slabs may be moved through the furnaces in either single or double rows.

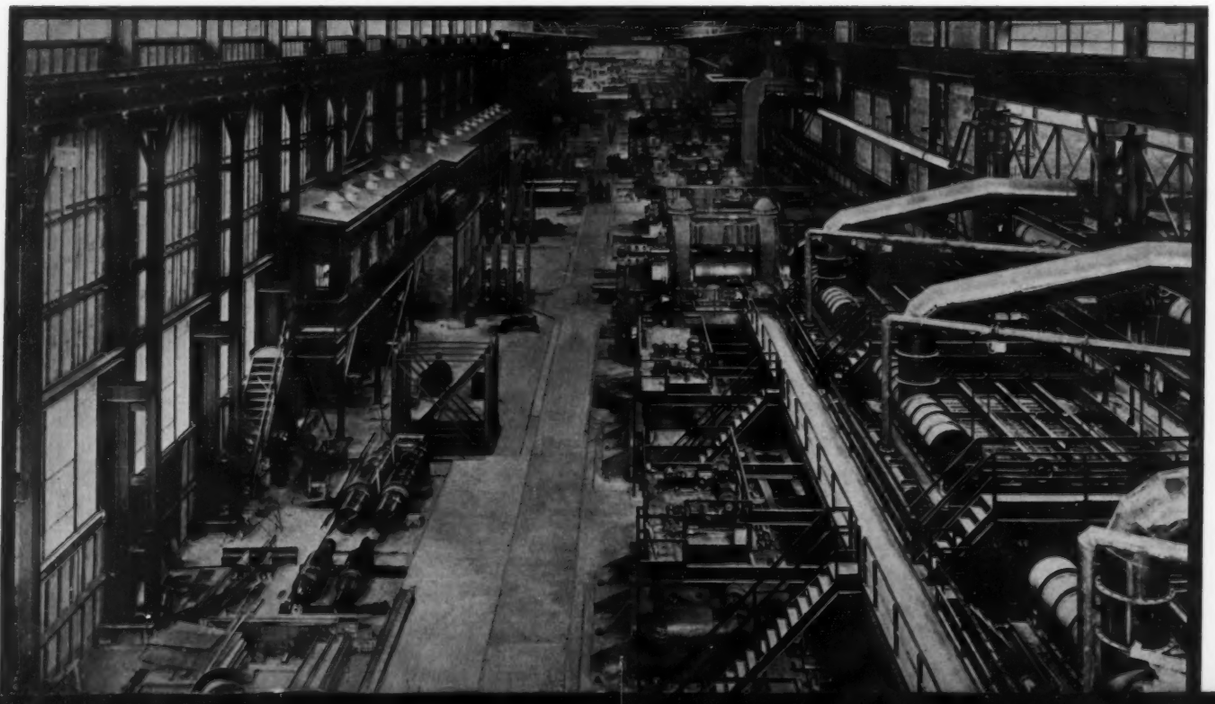
Slabs coming to the strip mill may range 7′–6″ to 16′–0″ in length, 34″–48″ in width, and 3″–6½″ in thickness.

HOT MILL FURNACES

Heating facilities for the strip mill consist of three continuous triple-fired furnaces, each with a rated capacity of 50 gross tons of steel per hour. The effective hearth dimensions are 18 ft. width by 80 ft. length. Of the latter, 16′–9″ is devoted to soaking zone, in which the solid hearth is built up of a special plastic chrome material. Eight gas burners overfire the soaking zone, while the main heating zone, through which the slabs move on water cooled skids, is top and bottom fired, with six gas burners in each location. Each zone is separately controlled, which permits good operation over a wide range of production, giving a well soaked slab with a minimum scale loss.

Located beneath each furnace are two refractory tile recuperators in which air for combustion is heated to about 800 degrees F. Air is pulled through the recuperators by motor driven fans rated at 45000 c.f.m. at

General view up through the hot mill building. Furnaces are shown in the right foreground.



R. J. WYSOR

PRESIDENT

PICTURES, INC.

2½″ water pressure and 800 degrees F. Furnaces are completely insulated and steel encased. The hearth is insulated with 5″ of insulating brick under 12″ of firebrick in the heating zone, and 10″ of insulating brick under 12″ of firebrick in the heating zone, and 10″ of insulating brick under 7½″ of firebrick and 4½″ of plastic chrome material in the soaking zone. Sidewalls are 19″ thick. Furnace roofs are of flat suspended arch construction. Each furnace is served by a steel stack 125 ft. high.

The fuel used is natural gas at present, but future plans call for the use of coke gas or a mixed gas. Fuel consumption under steady operation runs about 1,650,000 Btu. per ton of steel heated.

Automatic temperature control regulates the input of fuel gas to the soaking zone of the furnace. Gas supply pressure to the furnaces is maintained at about ½ lb. per sq. in. by automatic regulation. Fuel air ratio is maintained at the desired setting for each firing zone by automatic regulators actuated through oil-hydraulic cylinders from orifice plates located in the gas and air lines, giving metered proportions of gas and air. Furnace pressure is also automatically controlled, the impulse being taken at the roof of the furnace and operating through a regulator and oil-cylinder to a counter-balanced sliding damper. Furnace pressure may be plus .2″ water column. These controls, together with gauges, recorders and gas meters, are mounted on a control panel for each furnace.

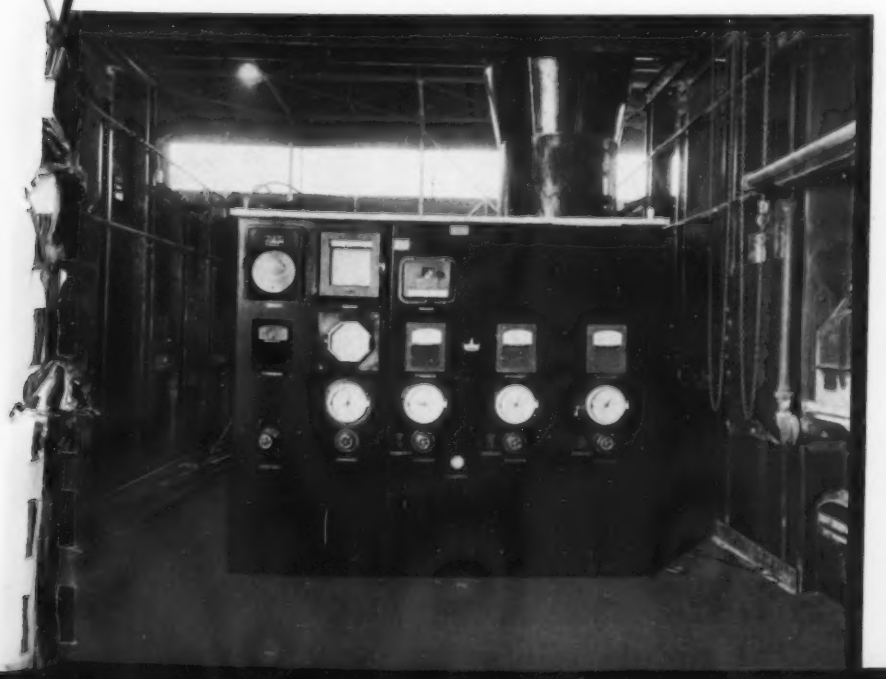
Slabs, at rolling temperatures averaging about 2250 degrees F., are moved through the furnace by the action of the pushers. Six bumpers, each with a cluster of 80,000 lb. capacity springs, absorb the impact of the hot slabs as they slide down onto the delivery table.

This table is 118 ft. long, with 59 cast steel rollers 14″ in diameter, and is sectionalized into three parts, each driven by a 50 hp., 550 r.p.m., d-c. motor.

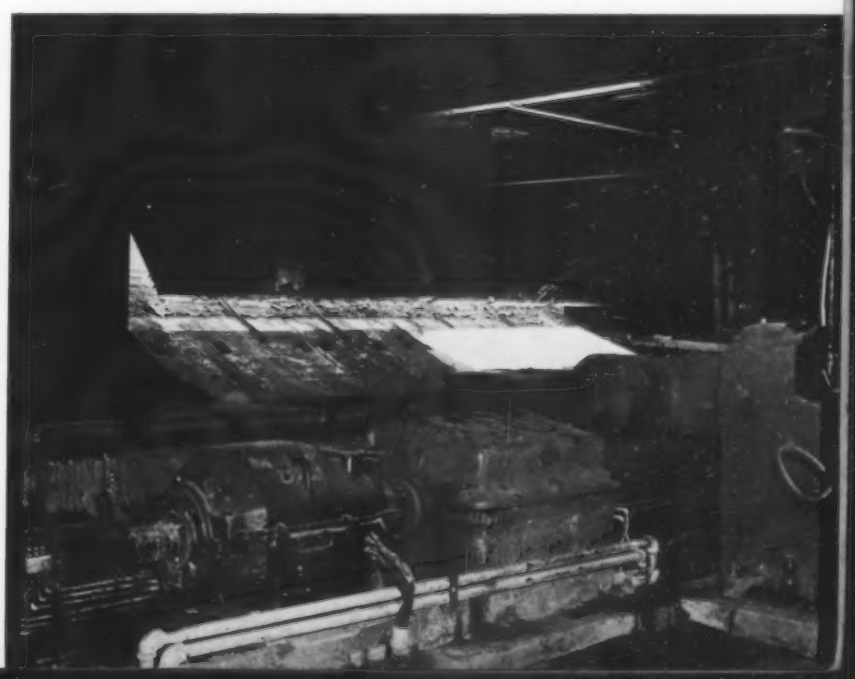
HOT MILL

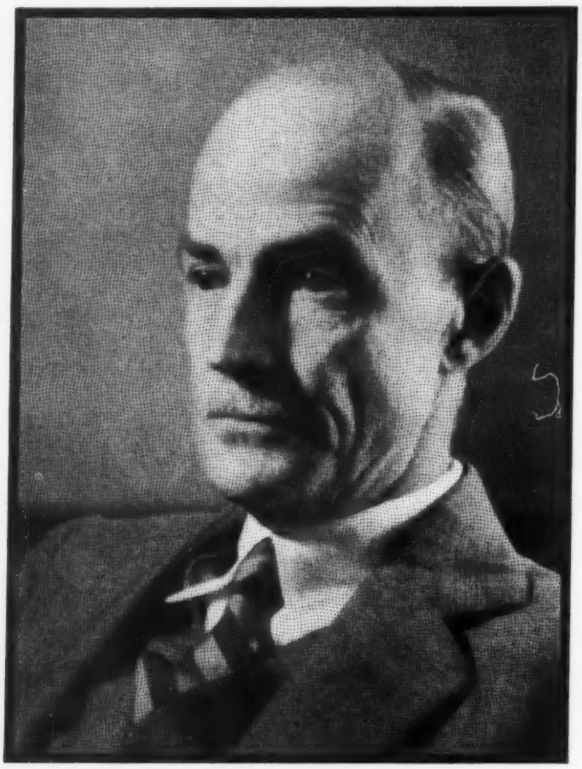
Passing over the delivery table, the slab approaches the hot mill, the first unit of which is a 2-high, 28″ x 56″ scale breaker designed for a maximum reduction of 15 per cent, and driven by an 800 hp., 2300 volt, 360 r.p.m., a-c. motor. The light reduction taken in this

Furnace control and meters, of which there is a very complete installation, are grouped on a separate panel for each furnace.



Heavy spring bumpers absorb the impact of the hot slab as it slides onto the delivery table.





MYRON A. WICK, VICE PRESIDENT
IN CHARGE OF FINANCE

stand is sufficient to crack loose the primary scale, which is then removed by hydraulic sprays under a 1200 lb. per sq. in. Next, at a distance of 26 ft., is located the broadside mill, a 4-high, 40″ and 53″ x 110″ stand driven by a 3000 hp., 514 r.p.m., 2300 volt wound rotor motor. Slabs may pass through this stand straight-away, or, if not exceeding 8 ft. in length, may be cross-rolled in order to spread them to a greater width than 48″, which is the greatest slab width available. A slab turner is placed on both sides of this stand to bring the piece into position for broadside rolling and then restore it to its original axis. Each turntable is driven by a 25 hp., 650 r.p.m., d-c. motor. A heavy duty motor operated slab pusher is also provided on the entry side of the broadside mill, insuring proper entry of the slab into the rolls.

A mechanically actuated slab reducer follows the broadside mill, and serves to square and true up slabs, and to size slabs as to width. It has a 7″ stroke, and is designed for 3″ penetration on a slab 6″ thick by 10 ft. long. It is driven through a 100:1 gear reduction by a 500 hp., 500 r.p.m. pedestal type d-c. motor.

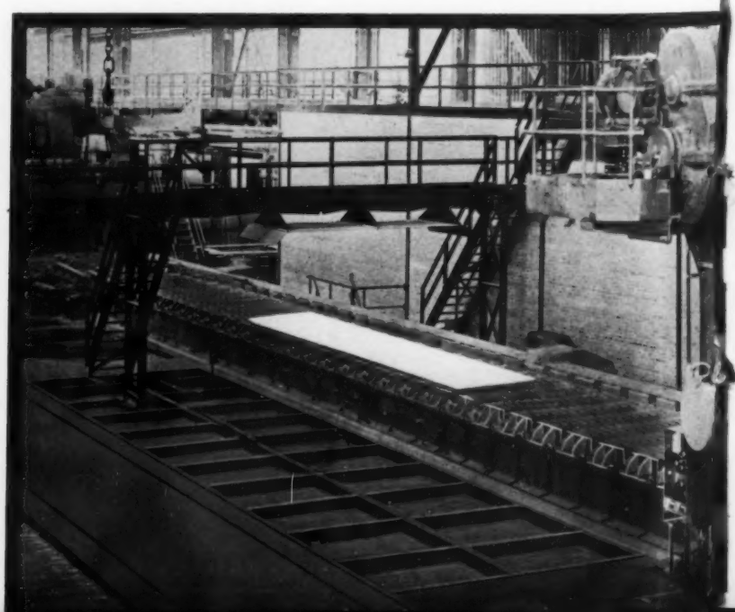
Following the slab reducer are three 4-high, 27″ and 53″ x 98″ roughing stands, each driven by a 3000 hp., 514 r.p.m., 2300 volt wound rotor motor. The roughing stands are spaced 48 ft., 56 ft., and 87 ft. apart respectively, so that the slab is in but one stand at a time. The last three roughers are equipped with integral vertical edging rolls, 24″ in diameter, with a working length of 8″, and an adjustable range of 32″ to 98″, designed so as to eliminate the use of universal spindles, and to facilitate roll changing without dismantling any part of the edger. Each edger is driven by a single 200 hp., 400/800 r.p.m., 230 volt d-c. motor, mounted on top of the mill housing, and is completely equipped with roller bearings. Edger roll speed is synchronized with main roll speed. Hydraulic sprays are placed between each edger and rougher to remove any secondary scale from the strip.

The table following the roughing stands is 145 ft. long, and is divided into two sections, each made up of 22 hollow cast iron rollers 14″ in diameter cooled by water sprays under the rollers, and each driven by a 55 hp., 250/1000 r.p.m., d-c. motor, giving a table speed of 100 to 400 ft. per min. At this point, slab temperature is carefully watched, being measured by a radiation pyrometer. Similar records are also made on each slab at the broadside mill, at the last finishing stand, and at the coiler or piler.

Following this table is the finishing train, the first unit of which is a 2-high 28″ x 98″ scale breaker driven

Primary scale is cracked loose in the roughing scale-breaker and removed by hydraulic sprays.

The delay table, between roughing and finishing trains, is composed of hollow cast iron rollers cooled by water sprays.



by a 600 hp., 150/600 r.p.m., 600 volt d-c. motor, and followed at a distance of 23 ft. by the six finishing stands, spaced on 18 ft. centers. These stands are all 4-high, 27″ and 53″ x 98″ units, each driven by a 600 volt d-c. motor. The first four drives are 4500 hp., 125/250 r.p.m. units, the fifth is 4500 hp., 125/264 r.p.m., and the last is 3500 hp., 150/300 r.p.m.

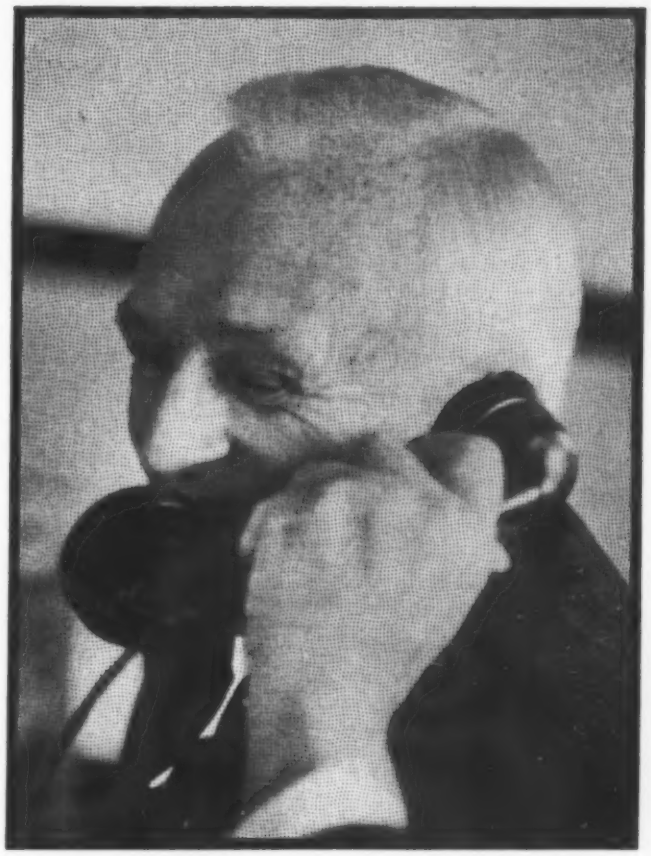
The finishing stands and three roughing stands are identical in design, being 29′–5½″ high and 22′–6″ wide at the top, with closed top, and standing on cast steel bed plates 9′–1″ below the mill floor. They have housing windows 5′–1″ x 17′–2″, with posts 30″ square. Back-up rolls in these stands are interchangeable. Work rolls for the first three roughing stands are of nickel grain cast steel with a 63–65 scleroscope hardness. The first four finishers use work rolls of a similar material but with a hardness of 68–72, while the last two finishers have work rolls of a special process cast steel with a hardness of 80 or more. All mill pinions and spindles are made from chrome-vanadium steel.

The finishing scale breaker is equipped with a double hydraulic spray, and in addition, a steam jet at each finishing stand insures a strip surface free from dirt or scale.

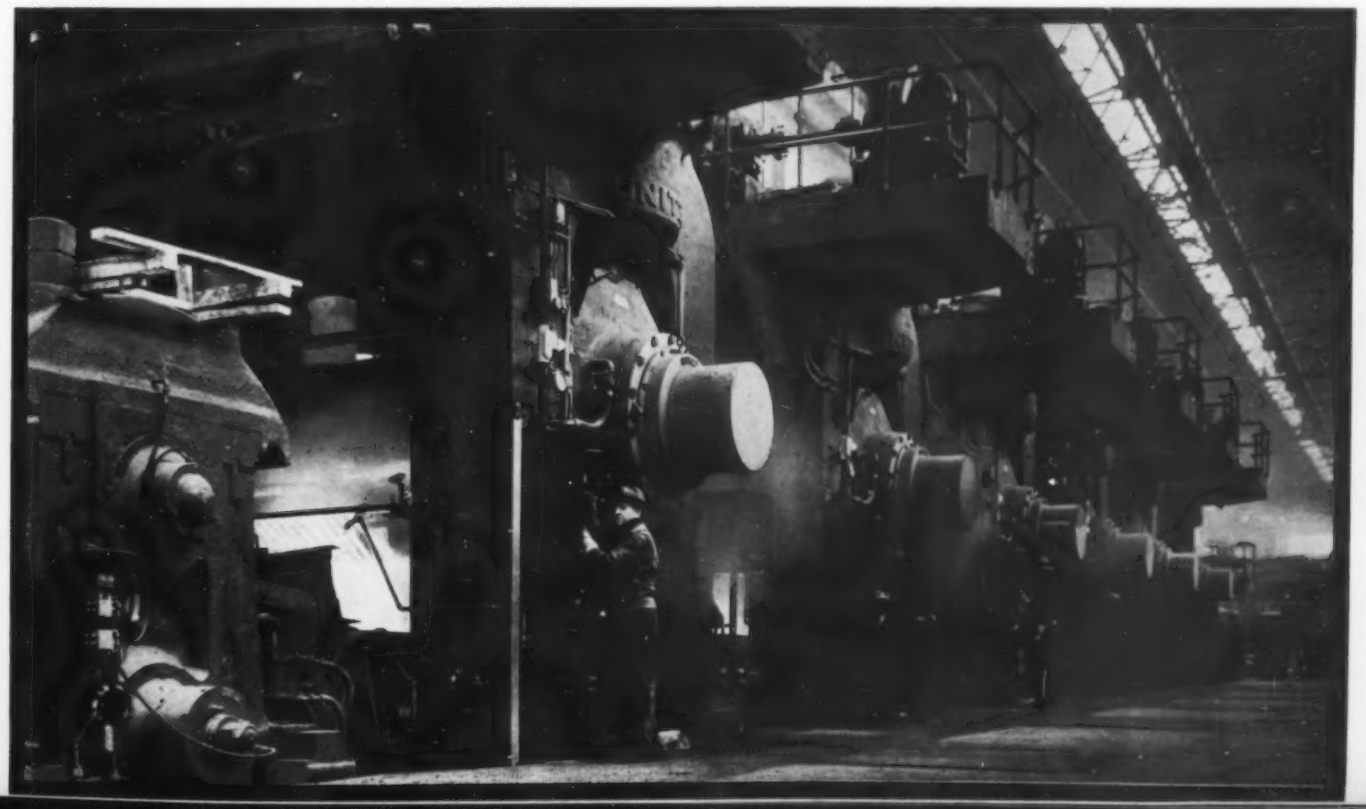
Hydraulic balance is maintained in all roll assemblies in all mill stands. For this purpose, oil-hydraulic pressure of 1500 lb. per sq. in. is maintained in two independent systems, one actuating the roughing stands, the other the finishing stands. Each system consists of a 6″ hydraulic accumulator and a 4.15 g.p.m. oil pump driven by a 5 hp., 1200 r.p.m., a-c. motor. This balance is so arranged that any single work or back-up roll in any mill can be removed without affecting the pressure on any other roll.

Rolls are changed with the aid of a large roll-changing hook 31 ft. long, weighing 20 tons. Suspended from the crane, the hook is slipped over the end of the roll and leveled by means of the auxiliary crane hoist. A similar hook is used on the cold mills.

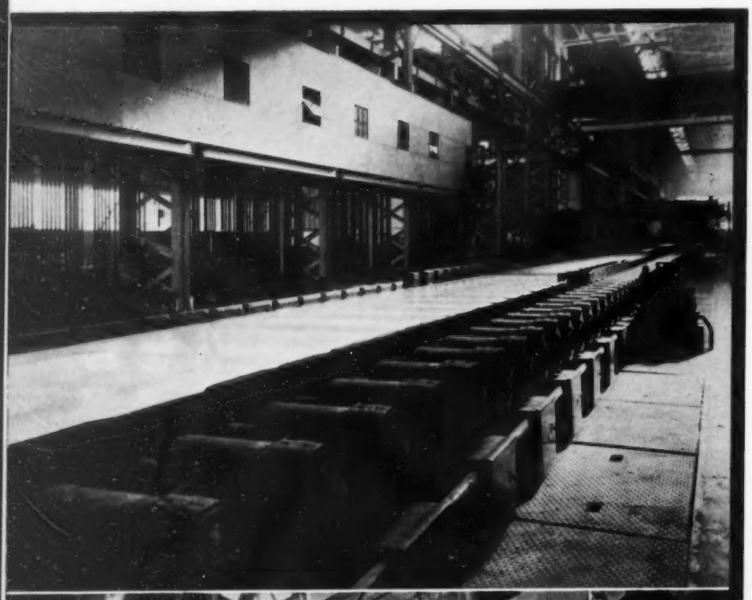
All work rolls in the mill are equipped with four-row tapered roller bearings, while oil-flooded tapered sealed sleeve bearings are used on the back-up rolls. Roller bearings have also been applied to all mill pinions, in place of the more usual babbitted bearings, and to the main drive reduction gears and the edger rolls and

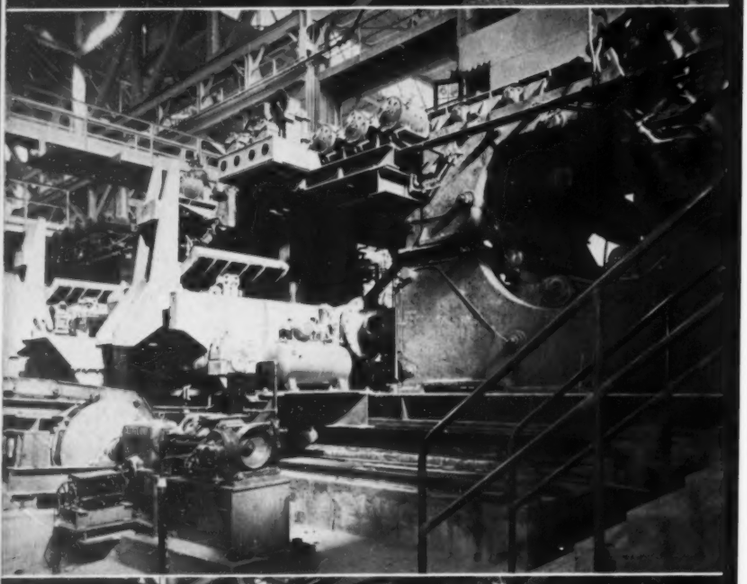


DONALD B. GILLIES
VICE PRESIDENT



The finishing train is made up of a scalebreaker, followed by six 4-high finishing stands.





drive gears. This preference for anti-friction bearings is also evidenced throughout the plant on such auxiliaries as table rolls, conveyors, reel drives, screwdowns, pinch rolls, trimmers, shear drives, etc.

Screwdown drives on the hot mill are as follows:

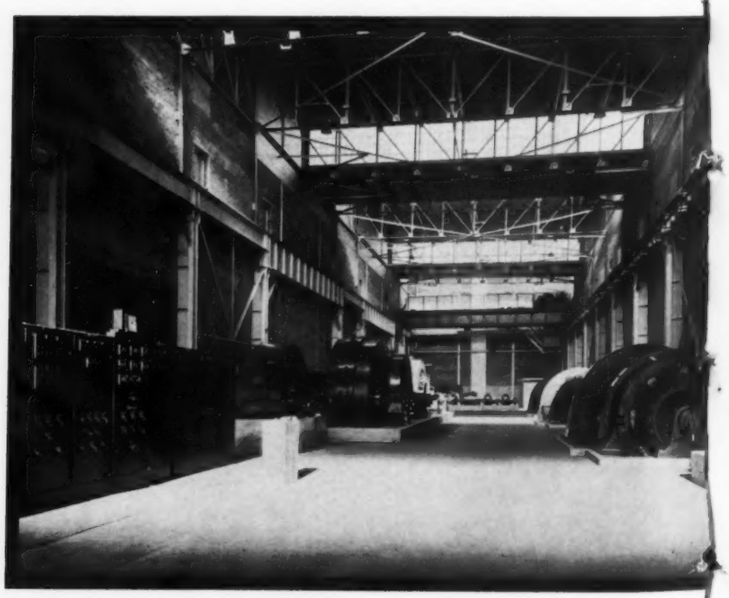
		H.P.	R.P.M.
Roughing scalebreaker	(1)	35	575
Broadside mill	(1)	75	525
No. 2 Rougher	(2)	35	575
No. 3 Rougher	(2)	35	575
No. 4 Rougher	(2)	75	525
Finishing scalebreaker	(2)	15	725
No. 5 Finisher	(2)	75	525
No. 6 Finisher	(2)	75	525
No. 7 Finisher	(2)	75	525
No. 8 Finisher	(2)	75	525
No. 9 Finisher	(2)	75	525
No. 10 Finisher	(2)	50	550

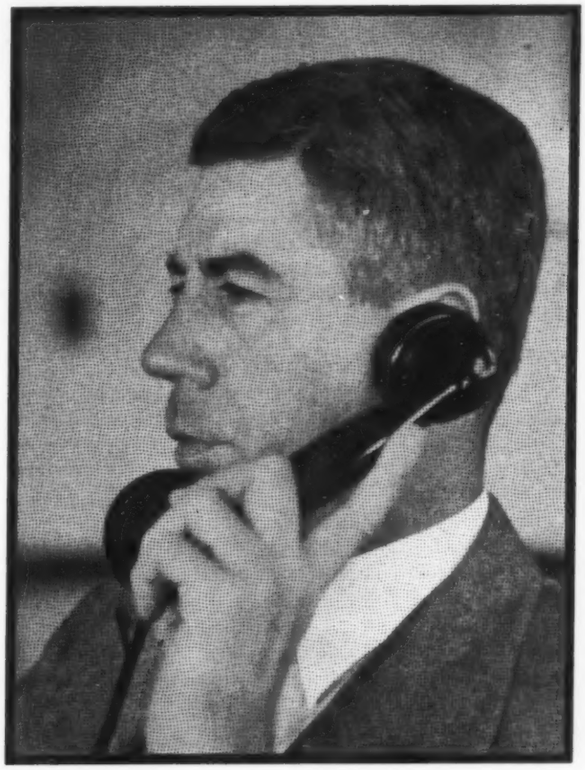
All of these motors are 230 volts d-c. Where two motors are installed, screws may be operated individually, or, through a magnetic clutch, in unison. Each screwdown is equipped with a remote indicating system showing roll position on indicators in the speed control pulpits as well as at the roll stands.

Loopers, to take up any slack between the finishing stands, are actuated by torque type d-c. motors controlled from a special motor generator set.

Left—Over hot mill runout table, which is driven by individual d.c. table roll motors, the strip is taken either to the coilers or to the transfer. This is the first mill ever designed with runout tables and coilers driven by individual d.c. motors.

Below—The hot mill motor room represents the greatest concentration of rotating electrical machinery, in power per square foot, of any industrial plant.





C. M. WHITE, VICE PRESIDENT
IN CHARGE OF OPERATIONS

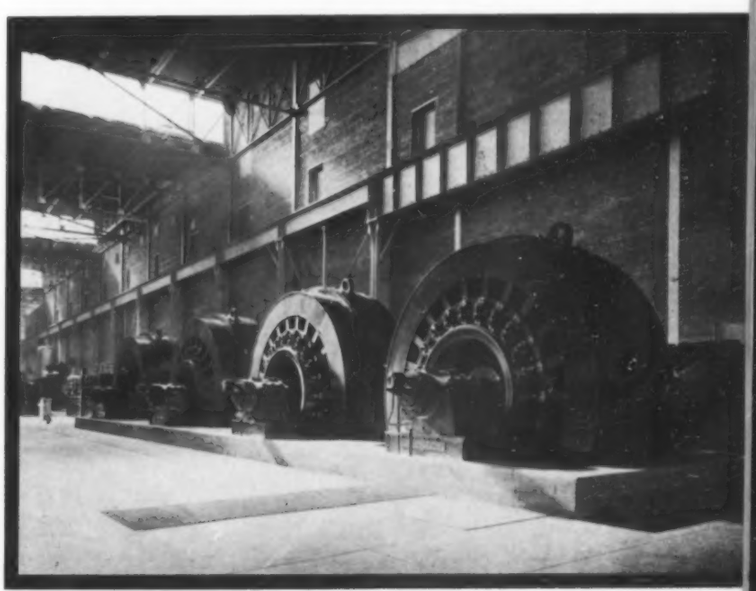
N. J. CLARKE, VICE PRESIDENT
IN CHARGE OF SALES

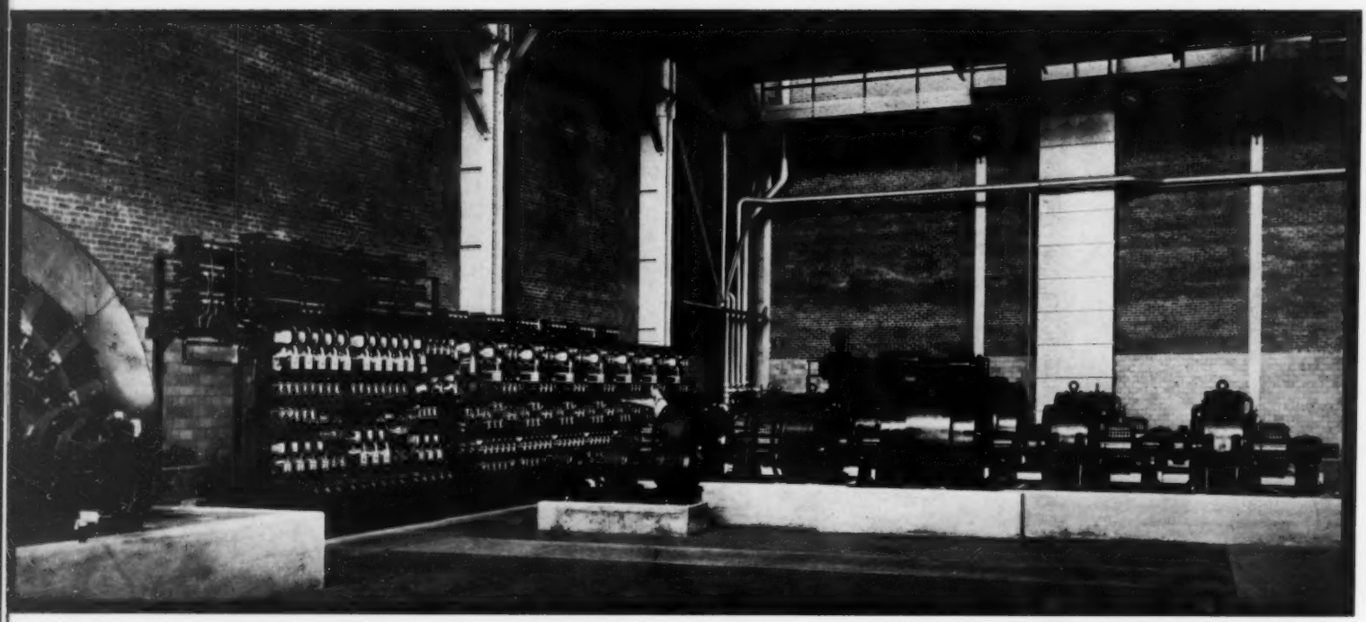
Gear ratio, roll speed and strip speed in the hot mill are as follows:

	Gear Ratio	Roll R.P.M.	Strip Speed Ft. per Min.
Roughing scalebreaker	12.2	29.5	208.5
Broadside mill	26.8	19.2	200
No. 2 Rougher	16.2	31.7	224
No. 3 Rougher	11.6	44.2	313
No. 4 Rougher	8.4	60.8	430
Finishing scalebreaker	11.5	13 /52	94/ 376
No. 5 Finisher	4.1	30.7/61.4	217/ 434
No. 6 Finisher	2.4	52.8/105.6	374/ 748
No. 7 Finisher	1.6	78.6/157.2	562/1124
No. 8 Finisher	1.2	108.6/217.2	760/1520
No. 9 Finisher	Direct	125 /264	882/1860
No. 10 Finisher	Direct	150 /300	1060/2120

Thirteen feet beyond the last finishing stand is located a flying shear for cropping or cutting sheets to desired lengths. Two sets of drums are used, one for cutting lengths of 13–27 feet, and the other for 28–50 ft. lengths. The shear is designed to cut ½" plate, and exerts a knife pressure of 540,000 lb. By making the bottom drum of the shear eccentric, the front crop of a strip is pulled by gravity down into a chute located just beyond the knife, thus affording a novel, effective

Four of the six main finishing drives. They are 4500 h.p. variable speed 600 volt d.c. shunt motors.





View of motor-generator sets and control boards serving the individual d.c. motors driving runout table and coilers.

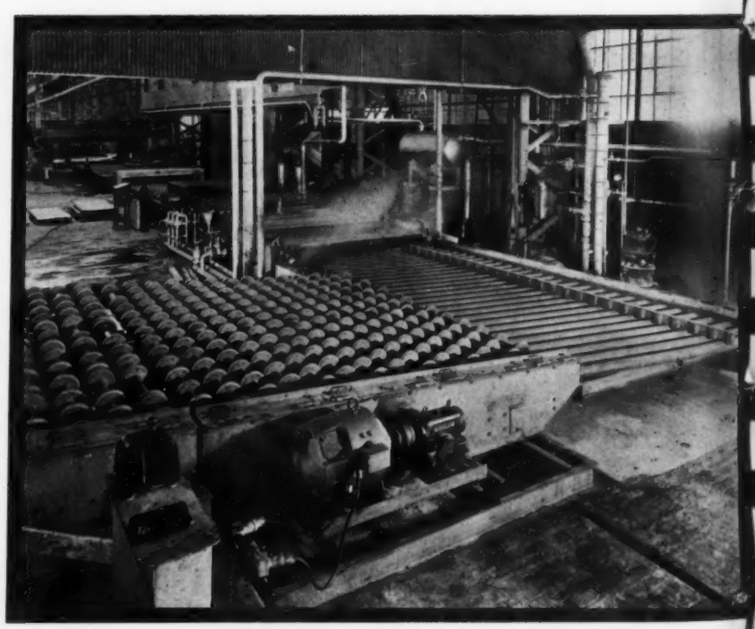
way for catching the crop. The shear is driven by two 250 hp., 400/1000 r.p.m., d-c. motors synchronized with the last finishing stand.

From the flying shear the runout table proceeds for a distance of about 350 feet, where two hot coilers are located below the table level, capable of rolling coils up to 375 lb. weight per inch of width, of strip up to ¼" in thickness, at speeds of 971–2566 ft. per min. Each coiler includes seven coiling rolls and two pinch rolls, each roll driven by individual totally enclosed shunt wound d-c. motors of 600 lb. ft. maximum torque, 700 r.p.m., 250 volts. Strip is fed into the coiling rolls through an air-operated gate, and an air-operated ejector removes the coil from the reel onto an up-ender mounted on a shuttle car. The coil is upended onto a transfer conveyor which takes the coil to the adjoining storage building, where it is transferred to a similar conveyor running at right angles to the first, where it cools and is weighed. It may then be removed for storage, or it can continue on a gravity type conveyor back into the hot mill for further processing.

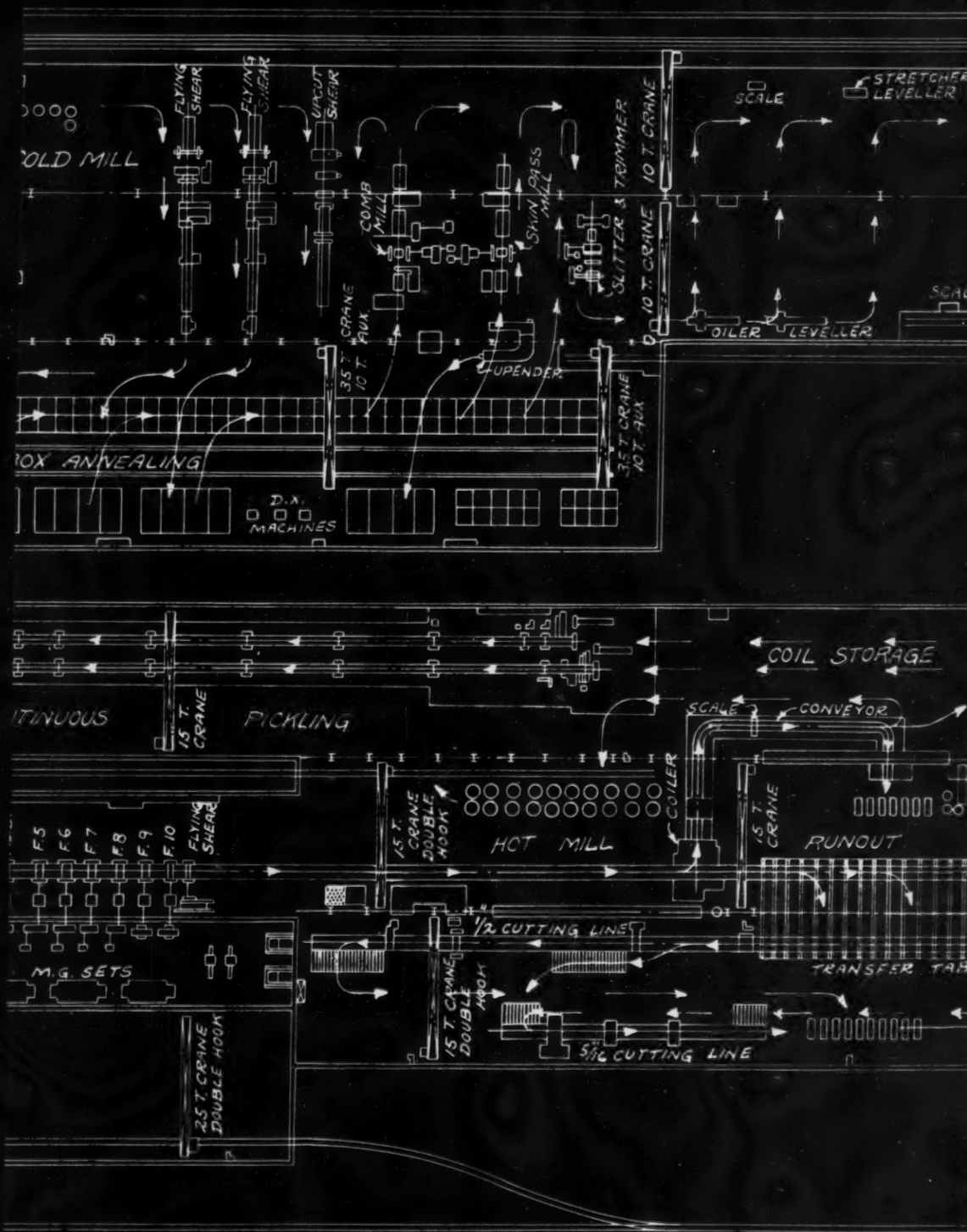
The runout table proceeds for 262 ft. beyond the coilers to a depression type end piler, where plates cut to length by the flying shear may be piled. Between the flying shear and the coilers, water sprays extend along the table for a distance of 120 ft., for cooling purposes.

The runout table is composed of 278 hollow alloy cast iron rollers, ground smooth, with grain cast iron aprons between them. Each roller is driven directly by a totally enclosed d-c. motor, of 4½ hp., 140 lb. ft. maximum torque, 750 r.p.m., 250 volts. These motors are of mill type construction, similar to the Iron and Steel standard mill type auxiliary motor, but specially adapted for runout table service. They are equipped with ball bearings. The table motors are divided into five Ward-Leonard control groups, each group receiving adjustable potential d-c. power from a 300 kw., 250 volt d-c. generator. Duplicate generators supply power to coiler motors, which are also controlled through a Ward-Leonard system. Thus, both tables and coilers are started and stopped entirely through voltage control by controlling the field of any particular generator. The runout tables attain a maximum speed of 2350 ft.

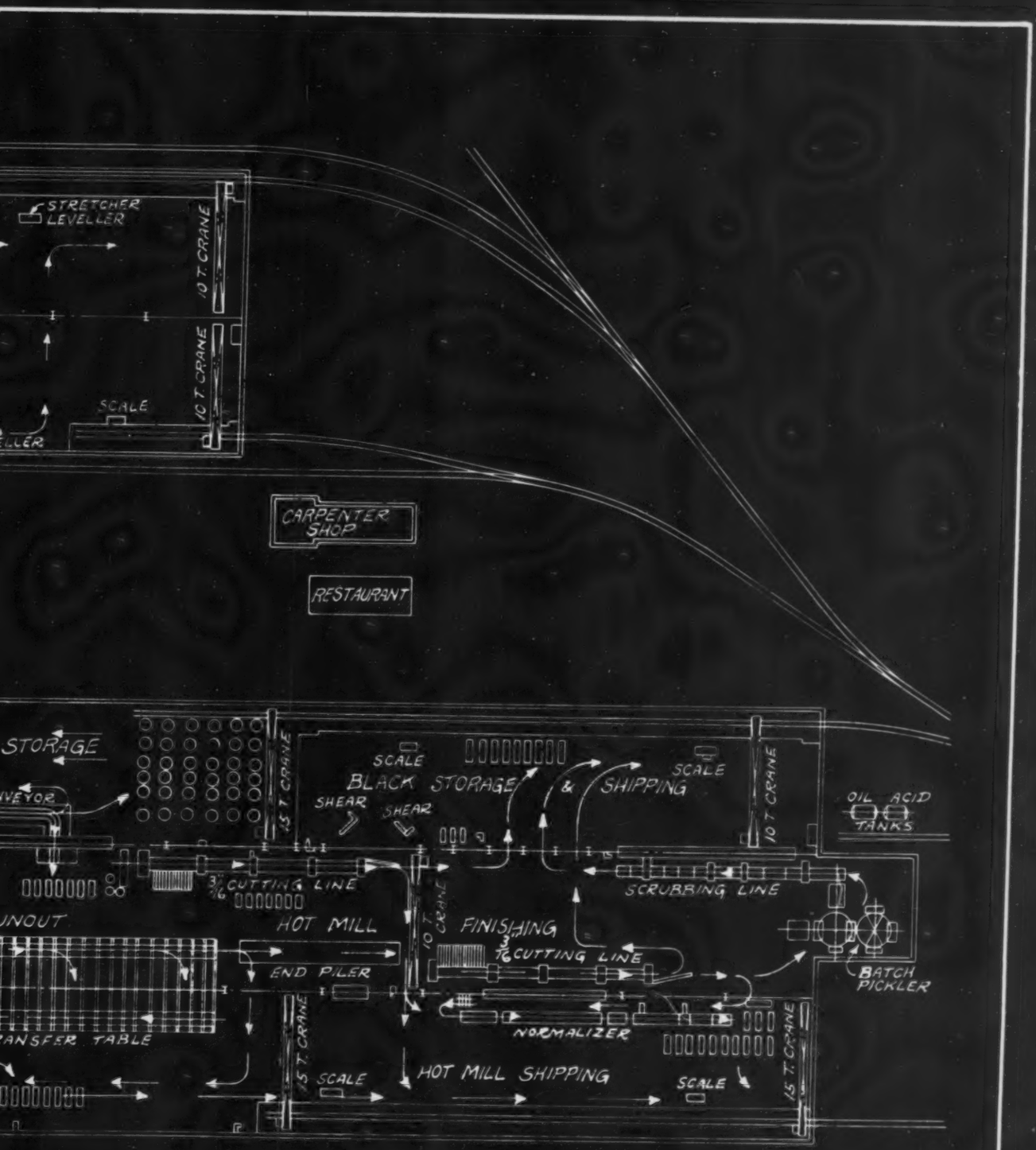
From the batch-pickler, sheets pass over this fiber disc conveyor and skew table to the cleaning and drying line.



REPUBLIC STEEL CORPORATION



EL CORPORATION - 98" CONTINUOUS HOT AND



T AND COLD STRIP MILL

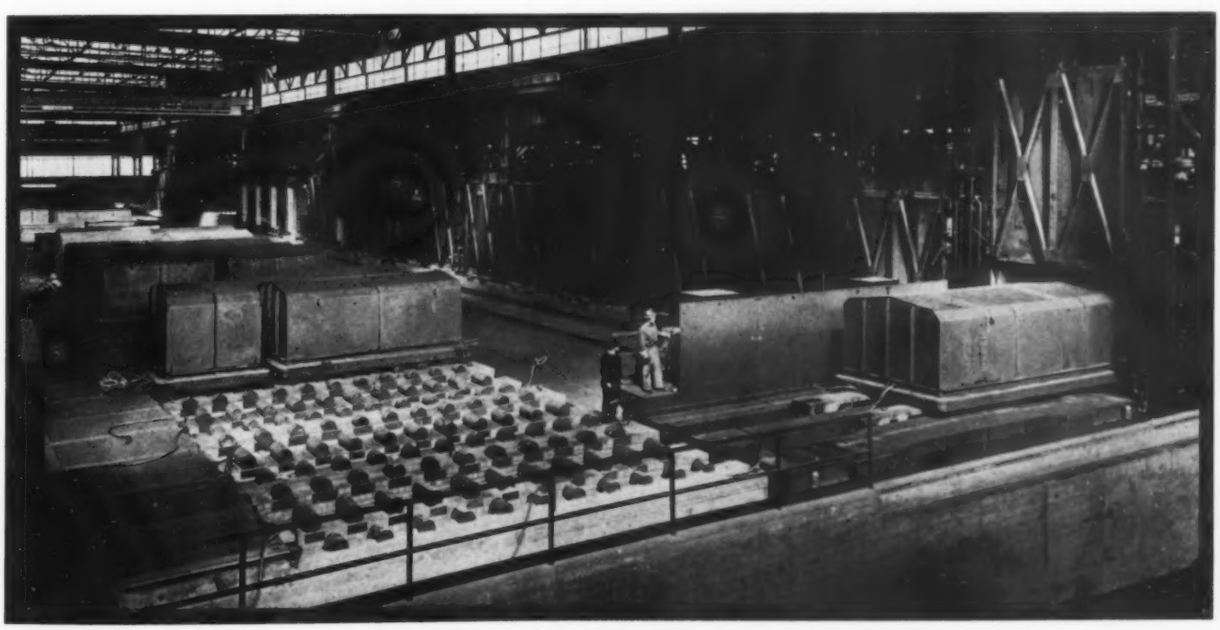
MILL DATA

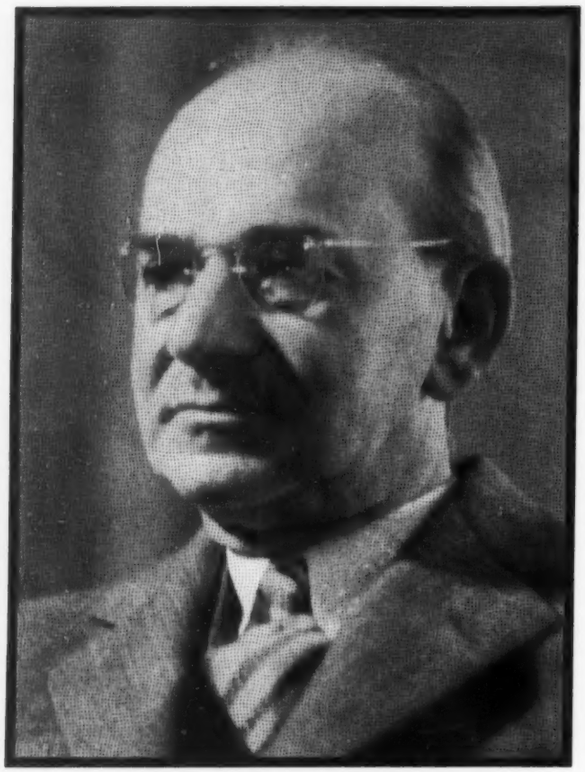
Mill	Characteristics	Roll Diameter		Roll Length	MOTOR				Remarks
		Work	Backup		H.P.	Voltage	R.P.M.	Type	
HOT MILL									
Roughing Scale-breaker	1-Stand, 2-High	28″	.....	56″	800	2300	360	a-c	Geared.
Broadside Mill	1-Stand, 4-High	40″	53″	110″	3000	2300	514	a-c	Double Geared. Flywheel.
No. 2 Rougher	1-Stand, 4-High	27″	53″	98″	3000	2300	514	a-c	Double Geared. Flywheel.
No. 3 Rougher	1-Stand, 4-High	27″	53″	98″	3000	2300	514	a-c	Double Geared. Flywheel.
No. 4 Rougher	1-Stand, 4-High	27″	53″	98″	3000	2300	514	a-c	Geared.
Finishing Scalebreaker	1-Stand, 2-High	28″	.....	98″	600	600	150/600	d-c	Geared.
No. 5 Finisher	1-Stand, 4-High	27″	53″	98″	4500	600	125/250	d-c	Geared.
No. 6 Finisher	1-Stand, 4-High	27″	53″	98″	4500	600	125/250	d-c	Geared.
No. 7 Finisher	1-Stand, 4-High	27″	53″	98″	4500	600	125/250	d-c	Geared.
No. 8 Finisher	1-Stand, 4-High	27″	53″	98″	4500	600	125/250	d-c	Geared.
No. 9 Finisher	1-Stand, 4-High	27″	53″	98″	4500	600	125/264	d-c	Direct.
No. 10 Finisher	1-Stand, 4-High	27″	53″	98″	3500	600	150/300	d-c	Direct.
COLD MILLS									
Tandem Mill	3-Stands, 4-High	20½″	53″	98″	(1) 1500	600	300/600	d-c	Geared.
					(2) 2500	600	225/450	d-c	Geared.
Tension Reel	.....	.....	.....	.....	600	230	250/875	d-c	Geared.
Combination Mill	1-Stand, 4-High	20½″	53″	98″	1500	600	300/600	d-c	Geared.
Sheet Mill	1-Stand, 4-High	20½″	53″	98″	500	600	200/400	d-c	Geared.
Hot Strip, Skin Pass	1-Stand, 2-High	30″	.....	98″	300	440	350	a-c	Geared.

per min., and can be taken from a dead stop up to maximum speed and back to a stop in thirteen seconds.

This mill is the first ever designed with runout tables and coilers driven by individual d-c. motors instead of the usual a-c. variable frequency system, and the same plan has been followed by two later installations. Advantages claimed for this plan are the reduction of power conversion losses, elimination of rotor losses of squirrel cage motors, simplification of control apparatus, and saving of substation space, while the smooth appli-

Twenty stationary batch-type furnaces, arranged in a single row of five batteries of four furnaces each, comprise the annealing facilities.





JULIUS KAHN, VICE PRESIDENT
IN CHARGE OF PRODUCT DEVELOPMENT

cation of torque to the rolls is expected to reduce breakage of shafts or couplings.

MOTOR ROOM

The hot mill motor room, 576 ft. long x 65 ft. wide, is located between the slab yard and the hot mill building. Here are housed all main hot mill drives, with their reduction gear sets, control equipment, switchgear, etc. Roughing stand motors are of wound rotor type, controlled through slip regulators. The d-c. motors driving the finishing stands are controlled by the Ward-Leonard system, and receive their power from three dual motor-generator sets also located in the motor room, each set consisting of two 3000 kw., 600 volt d-c. generators driven by a 7370 kva., 360 r.p.m., 11000 volt synchronous motor, with 250 volt excitation. Excitation of the synchronous motors is automatically adjusted from light to heavy loads, so as to insure good power factor regulation.

Auxiliary d-c. power for general purposes is supplied from two motor-generator sets, each made up of a 1500 kw., 250 volt d-c. generator driven by an 1875 kva., 514 r.p.m., 11,000 volt synchronous motor.

Power for the d-c. motors used on coilers and runout tables is derived from two special motor-generator sets. One of these sets consists of four 300 kw., 250 volt d-c.

Continuous pickling lines are about 503 ft. overall length. The wooden grids, which guide the strip through the looping pits, are shown here.

generators driven by a 1250 hp., 1200 r.p.m., 2300 volt motor. The second set is the same except that only three generators are incorporated.

Electrical machinery is cooled by a closed recirculating system, in which air is cooled in surface type coolers and blown into the motor room, which is thus kept under a slight pressure. The air passes down through the machines and back to the coolers. A circulation of 500,000 cu. ft. per min. is required, with a make-up of about 5 per cent.

All motors and generators in the motor room are equipped with ring-oiled bearings, each with an oil reservoir.

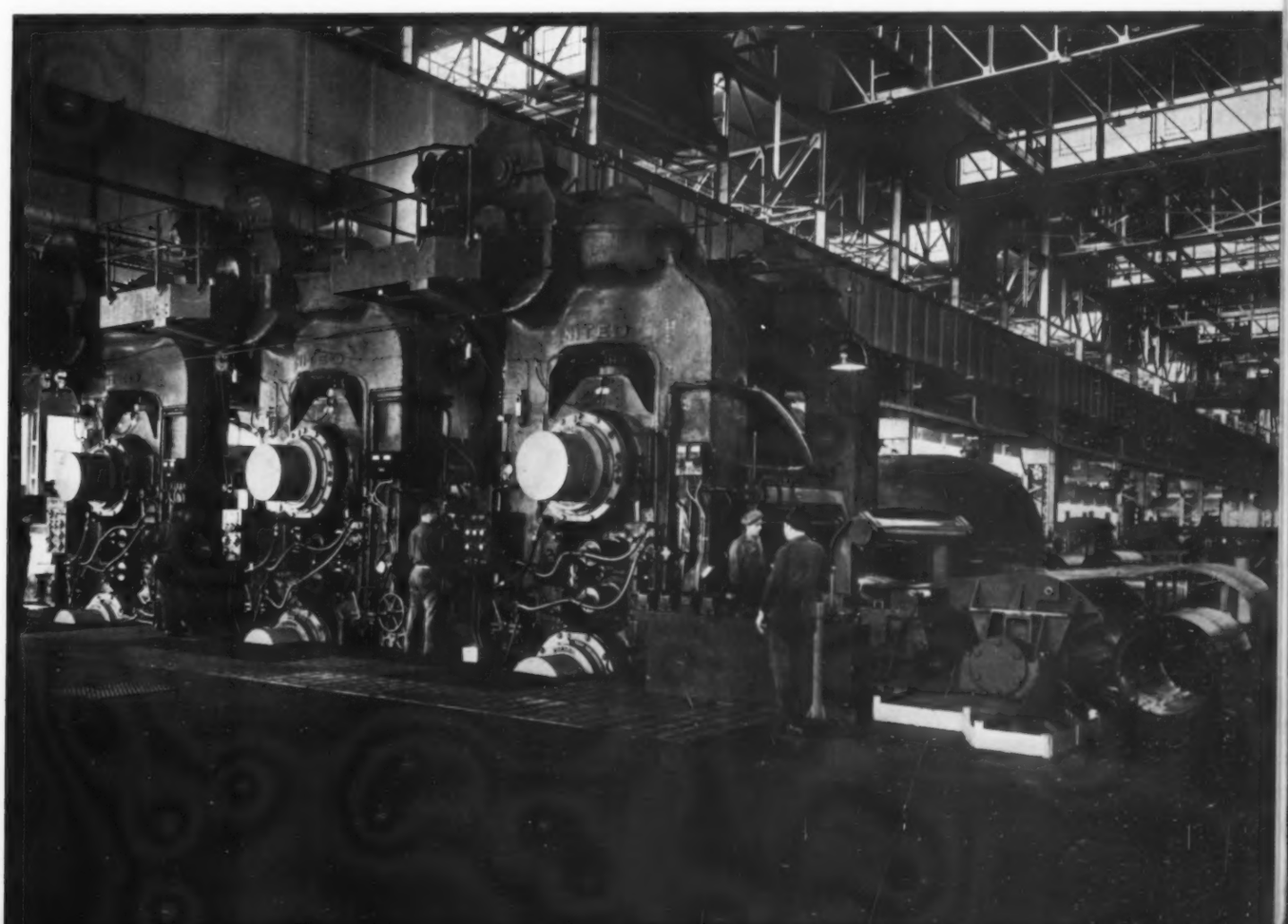
All oil circuit breakers which control the 11,000 and 2300 volt equipment are enclosed in metal clad units located on the main floor of the motor room. Design of the 600 volt bus structure is rugged and well spaced. All busses are of aluminum channel construction. Wherever possible, cables are installed in conduit, imbedded in concrete. All cable except overhead power feeders for general service are lead covered.

Power for this plant is purchased from the utility company at 11,000 volts, 60 cycles, and is brought to the motor room through an underground duct system. The larger M. G. sets are operated at 11000 volts. A 12000 kva. transformer bank provides 2300 volt power. Lighting distribution and auxiliary a-c. motors receive

W. W. HANCOCK

SECRETARY AND TREASURER

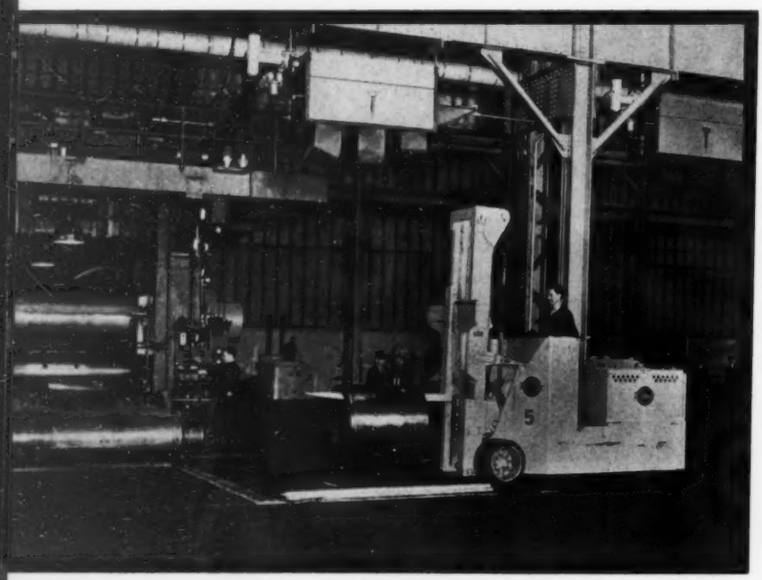
The tandem cold mill consists of three 20½" and 53" x 98" stands. Special emphasis was laid on speedy handling of coils to and from the mill.



P. F. BOYER, COMPTROLLER

power from a 3000 kva., 11000/440 volt transformer bank. All transformers are of non-inflammable, non-explosive pyranol type, making it possible to safely locate them in the motor room, thus saving on interconnections and vaults.

Every effort has been made to facilitate material handling throughout the plant. Considerable use has been made of tractors of various types.



The total electrical power demand of the mill is about 20,000 kva. The 11000 volt connected load totals 52,530 kva., made up of the following:

	K.V.A.
Main 11000/2300 volt transformer bank	12000
11000/440 volt auxiliary transformer bank	3000
Finishing train M. G. sets, 3 x 7370	22110
Auxiliary M. G. sets, 2 x 1875	3750
Cold mill M. G. set	7370
Cold mill M. G. set	4300
Total 11000 volt connected load	52530

The hydraulic pumps, which supply water to the descaling sprays along the hot mill, are located in a sump placed between the drive motors for No. 3 and No. 4 roughing stands. There are three multi-stage centrifugal pumps, each made up of a 2-stage and a 7-stage coupled pump, of 1200 g.p.m. capacity at 1200 lb. per sq. in. pressure. They are driven by 1250 hp., 2300 volt, 1750 rpm. induction motors. Water usage for descaling purposes averages about 1000 gallons per ton of product, while the instantaneous flow is about 4000 g.p.m. Supply water is stored in a 13000 gallon tank located just under the crane level in the hot mill. A welded hydro-pneumatic accumulator 25′–7″ high by 5′–0″ diameter serves to dampen pulsations and smooth out peaks in the discharge system.

In the north end of the motor room are located two air compressors which supply this service for the entire strip plant.

In the hot rolled finishing department, paralleling the mill runout table, is a cooling table, 213 ft. long, to which plates are brought from the runout table by a chain-drag transfer 208 ft. long by 38 ft. wide.

Four cutting lines are also located here, one for ½″ plate, one for 5/16″ plate, and two for 3/16″ plate. Speed ranges 100 to 300 ft. per min. through the lines.

The ½″ line is an extension of the cooling table mentioned above, and consists of an upcut shear and shear gauge, a 2-high plate leveler, a side piler, a rotary side trimmer, a second upcut shear and gauge, and a second side piler. The line is so designed that plates can be divided in the first shear as well as in the second shear, and can be cut to length with or without side trimming, as orders may require.

The 5/16″ line is made up of a magnetic depiler, rotary side trimmer, roller leveler, upcut shear and gauge, pinch rolls and piler. The depiler is of the overhead crane type, picking up a multiple number of plates and depositing them one at a time on the approach table.

The two 3/16″ lines are duplicates, except that one line is equipped for coils as well as sheets, and consequently has a processing uncoiler at the head of the line. Beyond this, each line includes a tilting type depiler for sheets, a roller flattener, an upcut shear and gauge, rotary side trimmer, roller leveler, and hand piler.

A normalizing furnace is also provided. It is 60 ft. long x 9 ft. wide, with roller type hearth. It is fired with natural gas, in three separately controlled zones,

consuming approximately 3,900,000 Btu. per ton of product. Speeds through the furnace may range from 2 to 40 ft. per min. Furnace capacity averages 120 tons per day for normalizing and about 250 tons per day for blue annealing. Two roller levelers are placed at the discharge end of the furnace.

Batch pickling may be effected by a vertical plunger type pickler designed to handle material from No. 22 gauge to 3/8" in thickness, and from 60" to 168" in length. There is also provided a scrubbing line, consisting of a loading conveyor, turntable, cross transfer conveyor, skew table, acid dip tank, water spray tank, caustic tank, scrubber, dryer, conveyors, skin pass mill, roller leveler, and piler. The turntable serves the pickler, and brings the pickle crates to the cross conveyor, where the sheets are dropped singly, conveyed to the skew table, and from thence to the scrubbing line. Passing through the acid dip tank, the sheets receive a light pickle in dilute sulphuric acid. The acid is removed by water sprays, following which is the caustic tank, containing a caustic soda solution at a temperature of about 180 degrees F., wherein all grease is removed. Subsequent scrubbing and drying, followed by the skin pass mill and roller leveler, completes the process. The mill is a single 2-high stand, a duplicate of the finishing scalebreaker, 30" x 98", driven by a 300 hp., 350 r.p.m., 440 volt, a-c. motor. The mill operates with a roll speed of 29 r.p.m. giving a delivery speed of about 228 feet per minute. This equipment can be used for "bright" pickling, for scrubbing and drying previously wet pickled sheets, for cleaning, scrubbing and drying hot rolled sheets either in the "as rolled" state, or in a pickled normalized or annealed condition, or for de-oiling and degreasing sheets.

CONTINUOUS PICKLING

For coils intended for full finished processing, pickling facitilities are provided in two continuous pickling lines, of about 505 ft. overall length. Each line consists of an uncoiler, a squaring shear, a stitcher, a looping pit, pinch rolls, four acid tanks, two rinse tanks, a dryer, pinch rolls, a shear and a recoiler. The looping pits are 22 ft. in length, of concrete construction lined with wood, and along each side wall are wooden grids which can be adjusted according to the width of the strip passing through.

Acid tanks are 60'–0" long x 8'–10" wide x 3'–9" deep, with a capacity of 13000 gallons, and are of welded steel plate construction, lined with 1/4" rubber, and faced with brick laid up in a sulphur compound. Water tanks are of similar construction, but of 25 ft. length, with a capacity of 4000 gallons. Tank covers are also of steel construction, rubber lined and coated with an acid-resisting compound, and are vented to the outside

This 96" skin pass mill is followed by a roller leveller, insuring a perfectly flat sheet.

through a scrubber and stack by an exhauster fan. Tanks are emptied by syphoning. A dancer roll mechanism in each acid tank is connected to pinch roll speed rheostats so as to automatically adjust speeds in accordance with the catenary assumed by the strip in the tanks.

Pickling is accomplished at strip speeds of 40 to 160 ft. per min., in a bath of 8–12 per cent sulphuric acid automatically maintained at a temperature of approximately 185 degrees F.

Space has been provided for a third line if it should be required.

COLD MILLS

From the pickling department, an underground pusher type conveyor takes coils to the cold mill depzrtment, which is made up of one tandem mill, a single stand combination mill and a single stand skin pass mill, all of 98″ width. Provisions have been made for duplicating these mills in a 60″ width at a future time.

The tandem mill consists of three 4-high, 20½″ and 53″ x 98″ stands spaced on 16 ft. centers, and capable of producing strip down to No. 24 gauge. The first stand is driven by a 1500 hp. motor, and the last two by 2500 hp. motors, all of 600 volts d-c. The mill is equipped with a tension reel driven by a 600 hp., 250/875 r.p.m., 230 volt d-c. motor. The reel is of collapsible type, 30″ in diameter x 98″ long, with hydraulic stripper and elevator of special design. Entry of the strip into the mill is effected through the use of a magnetic bender and motor driven air-actuated pinch rolls. Double air cylinders are incorporated in both the uncoiler and recoiler units, so that a coil may be prepared for entry to the mill, while another coil is passing through the mill, and a third coil is being removed at the delivery end, allowing a continuous flow of material through the mill.

The single stand combination mill is a 20½″ and 53″ x 98″ stand for rolling either coils or sheets, driven by a 1500 hp., 300/600 r.p.m., 600 volt d.c. motor. In line with this mill is a tilting table, an uncoiler, a tension reel, a leveler, oiler and piler. When rolling coils only the reels are operated, but for sheets all units except the reels are operated. The uncoiler is of drag generator cone type, while the tension reel is a duplicate of that used on the tandem mill.

The single stand sheet mill is similar to the combination mill, with the reels omitted. This mill is driven by a 500 hp., 200/400 r.p.m., 600 volt d-c. motor.

Speeds of these mills are as follows:

	Motor R.P.M.	Gear Ratio	Roll Speed R.P.M.	Strip Speed Ft. per Min.
No. 1 tandem stand	300/600	6.79	44/ 88	237/474
No. 2 tandem stand	225/450	3.67	61/122	329/658
No. 3 tandem stand	225/450	3.02	75/150	400/800
Combination mill	300/600	4.03	74/148	400/800
Sheet mill.....	200/400	4.03	50/100	267/534

All of the cold mills are equipped with tapered roller bearings on the work rolls and oil flooded bearings on the back-up rolls. Except for the diameter of the work rolls, the cold mill stands are duplicates of those used in the hot mill. The cold mill rolls are cooled by water circulated internally through the rolls. Instruments showing roll pressures in the cold mills aid materially in accurately maintaining strip gauge.

The tandem mill draws power from a motor generator set consisting of two 3000 kw., 600 volt d-c. generators driven at 360 r.p.m. by a 7370 k.v.a. 11,000 volt synchronous motor with 250 volt excitation. Power for the two single stand mills is derived from another motor generator set consisting of one 1500 kw., 600 volt, one 500 kw., 600 volt, and one 1500 kw., 250 volt d-c. generator, driven at 514 r.p.m. by a 4300 k.v.a., 11000 volt synchronous motor. Both of these sets, with their switching equipment, are located in the cold mill motor room, which is located at the end of the cold mill building.

The cold mill department further includes the following equipment:

Two drum type flying shear lines, each consisting of a newly developed hydraulic cone type uncoiler, pinch rolls, rotary side trimmer with automatic rotary type scrap cutter, looping tables, a roller leveler, flying shear, pinch rolls and piler. These lines trim and shear strip up to No. 12 gauge into lengths of 60″ to 200″, at speeds of 150–400 ft. per min.

One upcut shear line, composed of an uncoiler duplicating those on the flying shear lines above, a 4-high roller leveler, an upcut shear and gauge, pinch rolls and end piler. Strip ranging 30″–94″ in width may be handled, in sheet lengths up to 20 ft., in thickness up to .150″, and at speeds of 100–300 ft. per min.

One coil slitting line, made up of a hydraulic cone type uncoiler, pinch rolls, and a rotary slitting and side trimming shear with scrap cutter, pinch rolls and a tension reel duplicating those on the cold mills. This line will handle material up to .109″ thick, in widths of 30″–94″, at speeds of 150–450 ft. per min.

ANNEALING

Annealing facilities consist of twenty stationary batch type furnaces, each 14′–4½″ wide x 26 ft. long, arranged in a single row of five batteries of four furnaces each. An electrically driven charging car, of 200 tons capacity, serves to charge and draw the furnaces.

The furnaces are fired with natural gas, through ports at the base of the side walls, from four burners of ribbon flame type. Exit flues are located in the center of each chamber, below the hearth. Air for combustion is furnished for each chamber by an individual 2000 c.f.m. fan.

Furnace temperature is automatically controlled, and six-point recording pyrometers show temperatures at various points within the furnace charge. Safety gas shut-off valves are applied to each chamber, functioning in case of air failure.

Annealing covers are of welded steel construction, 10 ft. wide x 8′–8″ high x 12 to 24 ft. long. Fifty-five loading and cooling docks are located opposite the row of furnaces.

For deoxidizing purposes, cracked natural gas is furnished from three units with a capacity of 15000 cu. ft. per hour each. These units operate on a ratio of approximately six parts of air to one part of gas, and deliver a highly reducing gaseous product. Two refrigerators operating in conjunction with the cracking units serve to bring the temperature of the deoxidizing gas well below the dew point, thus ensuring the best possible surface on the annealed product.

LUBRICATION

Throughout the plant, lubrication has received considerable thought, and the result is a very complete installation of the latest types of lubrication equipment, lending itself to efficient and economical operation. Modern automatic systems have been applied to all important points. The large circulating oil systems have been applied to all important points. The large circulating oil systems are complete with the necessary pumps, oil coolers, and centrifuges. Alarms are sounded should lubrication from these systems fail. Details of the various systems, with their applications, are given in the accompanying table.

Process oil, such as is used for oiling sheets and strip, is piped from a main storage tank to a number of metered stations in the plant.

MISCELLANEOUS

Rolls for both hot and cold mills are cared for in the one roll shop, which is located at the end of the cold mill building. Equipment installed in this shop includes:

Two 28″ x 192″ roll grinders.
One 24″ x 192″ roll grinder.
One 53″ x 22′–0″ roll grinder.
One sand blast machine.

Steam requirements of the plant, which may reach peaks of 100,000 lb. per hour, are taken care of through a steam line connecting back to boiler houses at the blast furnace plant and at the blooming mill. From the blast furnace, a 10″, 250 lb. line, 2100 ft. long, crosses the valley under a city bridge, at the west end of which it meets the line from the blooming mill boilerhouse. The latter section is a 16″, 175 lb. line, 1650 ft. long. From this junction, the line proceeds for another 8000 ft. to the strip mill. This run is made

LUBRICATION DATA

Systems		Capacity		Lubricant		Number of Bearings Served	Equipment Served
Number	Type	Storage (Gal.)	Circulation (G.P.M.)	Type	Viscosity, Saybolt Universal at 100 Deg. F.		
1	Circulation	12,000	350	Extreme pressure oil	2300	48	Hot strip mill pinions.
1	Circulation	12,000	350	Extreme pressure oil	1700	76	Hot strip mill reduction gears.
1	Circulation	27,600	350	Highly refined mineral oil	2400	48	Hot strip back-up roll bearings.
1	Circulation	8,000	130	Extreme pressure oil	1700	43	Cold strip pinions and gears.
1	Circulation	12,000	150	Highly refined mineral oil	2400	20	Cold strip back-up roll bearings.
1	Circulation	500	40	Extreme pressure oil	500	40	Hot mill flying shear.
4	Circulation	500	30	Extreme pressure oil	500	48	Hot strip cutting and trimming lines.
1	Circulation	200	2½	Highly refined mineral oil	2400	4	Hot strip skin pass mill roll bearings.
2	Circulation	500	40	Extreme pressure oil	500	24	Cold strip cutting and trimming line.
17	Circulation	350	25	Compound oil	1500	108	Screwdown drives.
5	Circulation, high pressure	200	5		500		Hydraulic roll balance.
1	Circulation, high pressure	500			500		Furnace hydraulic charging equipment.
1	Time automatic pressure			Extreme pressure grease		320	Hot mill work roll bearings and miscellaneous.
3	Semi-automatic pressure			Roller bearing grease		2320	Table roll bearings and miscell.
1	Timed automatic pressure			Roller bearing grease		140	Hot strip coilers.
2	Timed automatic pressure			Extreme pressure grease		400	Cold mill work roll bearings and miscellaneous.
15	Hand operated pressure			Roller bearing grease		600	Miscellaneous points in hot mill, cold mill, picklers, etc.

up of 6500 ft. of 14″ pipe and 1500 ft. of 12″ pipe. The line is calculated for a 50 lb. pressure drop from an initial pressure of 170 lb. per sq. in. with a flow of 95,000 lb. per hour. The entire line is of welded construction and is built above ground, being supported on roller chairs setting on concrete piers. Expansion bends are placed in the line every 400 feet.

Water requirements of the mill will run about 30,000,000 gallons per day. Three double suction centrifugal pumps of 10000 g.p.m. capacity, with automatic controls, draw water from the Cuyahoga River through two self-cleaning strainers. A 350,000 gallon welded steel standpipe, 125 feet high, is incorporated in the water system.

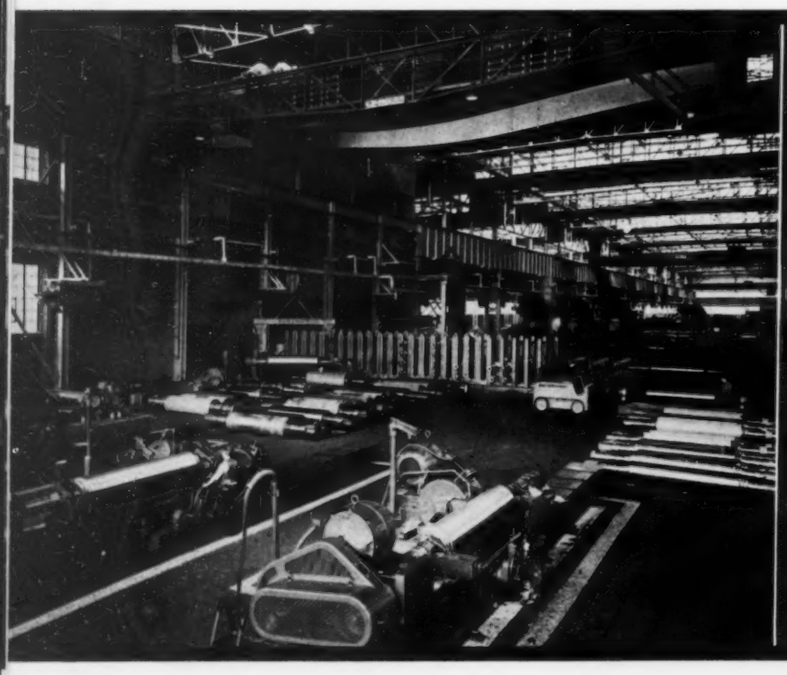
Buildings are of excellent construction, with high-and-low bay roofs, giving a maximum of light. Artificial lighting, with a general intensity of 15 ft.-candles, is made up of alternate mazda and high-intensity mercury units. Brick floors are used in the hot mill and pickling buildings, with wooden block floors in the cold mills and finishing departments. A complete modern welfare building affords locker and washroom facilities, while the office building also houses a testing laboratory and a complete dispensary.

Throughout the plant, much emphasis has been placed on safety. All moving machine parts are enclosed and well equipped with safety guards. All equipment is arranged so that it may be locked out of operation while inspection and repair work are in progress. Overhead cranes are reached only by stairways. Walkways are provided to carry men clear of operating areas.

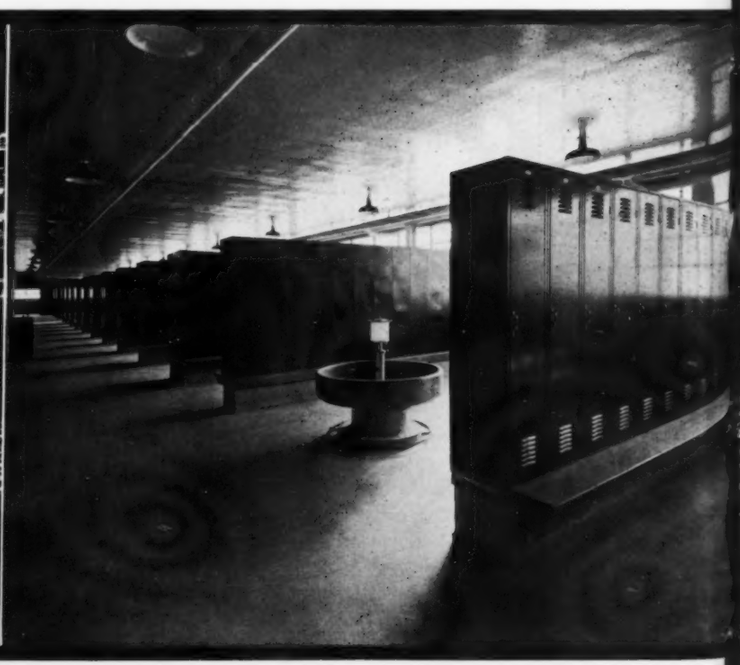
The plant layout is such as to render material flow smooth and constant, with no back-tracking or bottlenecks. The latest types of handling equipment are employed, so as to keep material flowing steadily to and from the producing units. Considerable use is made of ram tractors, of both tilting and non-tilting types. These units, of 16000 lb. capacity, are largely battery powered, with full contactor type control giving three speeds in both directions. They are designed for accessibility, and are strongly built, with back whele steering and two separate brake systems. An articulated sheet handler, of 10 tons capacity, is used in the shipping department for loading cars, and permits the loading of 10 ton bundles of sheets up to 48″ x 129″ through a 6 ft. car door, and up to 144″ long through a 10 ft. door.

SUMMARY OF ROTATING ELECTRICAL MACHINERY

	Number	H.P.
Motors—Hot Mill	897	90,000
Generators—Hot Mill	15	31,000
Total—Hot Mill	912	121,000
Motors—Cold Mill and Finishing	303	30,000
Generators—Cold Mills and Finishing	5	12,700
Total—Cold Mill and Finishing	308	42,700
Grand Total	1220	163,700



The roll shop, located at the end of the cold mill building, serves both the hot and cold mills.



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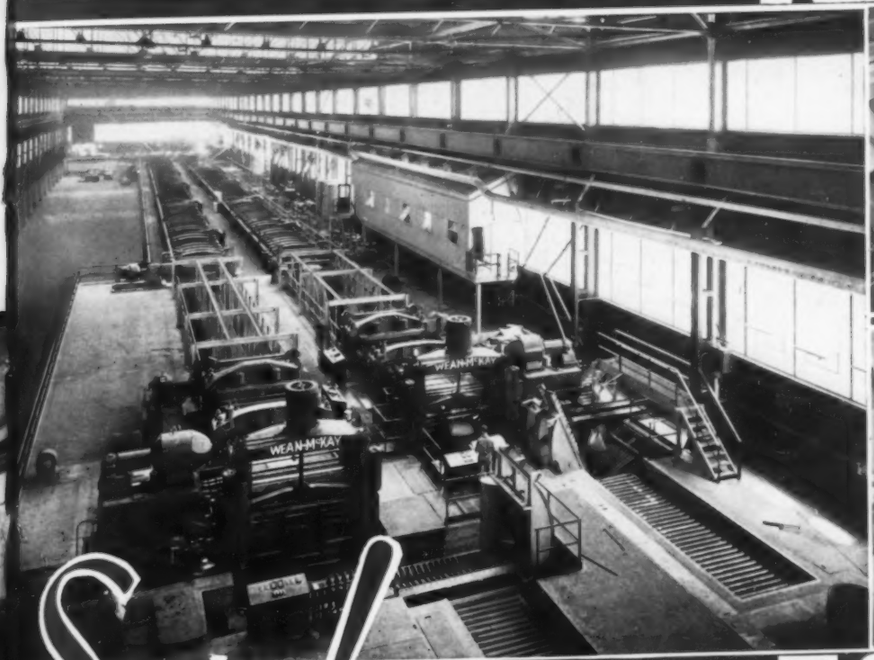

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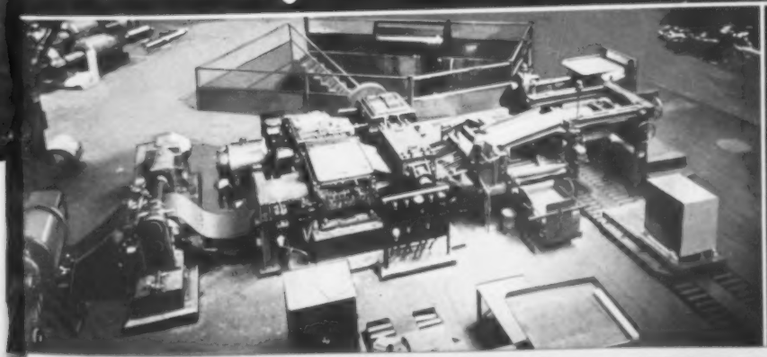
REPUBLIC INSTALLED WEAN EQUIPMENT



Associated Companies:

Lee Wilson Engineering Co., Cleveland, O.
The McKay Machine Co., Youngstown, O.
Flinn & Dreffein Co., Chicago, Ill.
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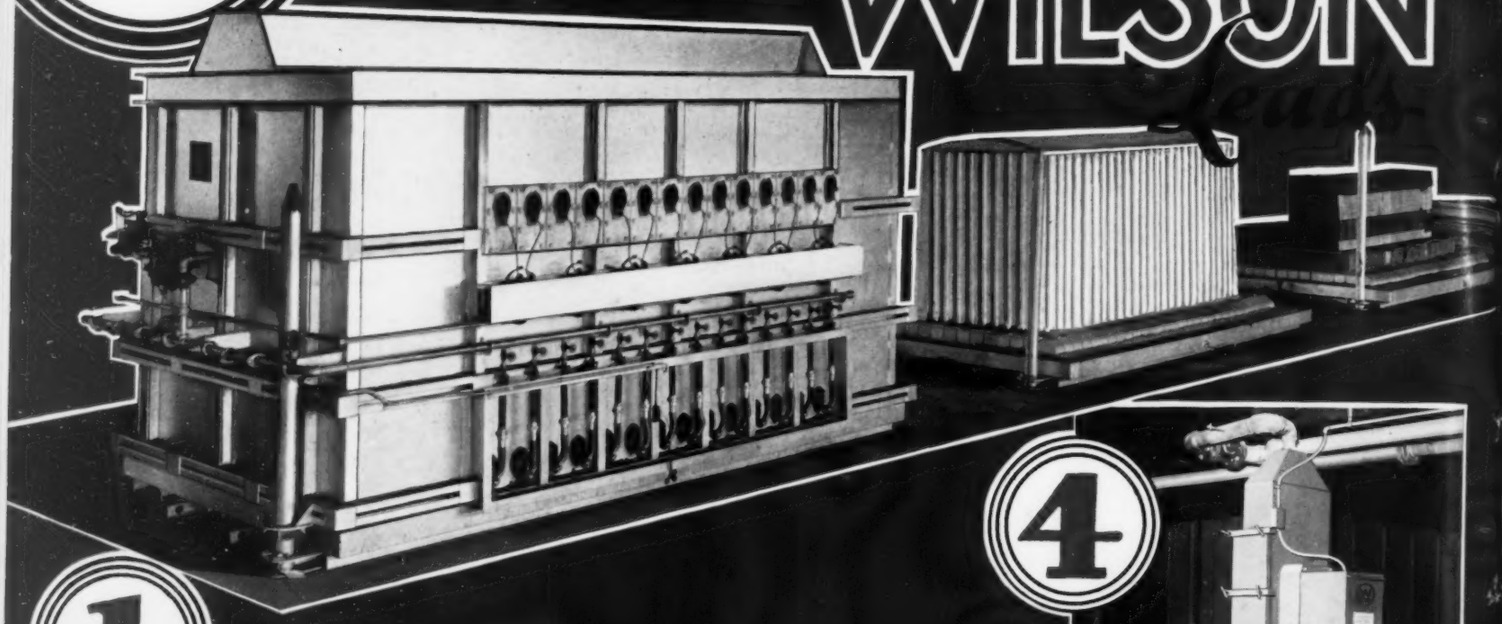
The Halldén Machine Co., Thomaston, Conn.

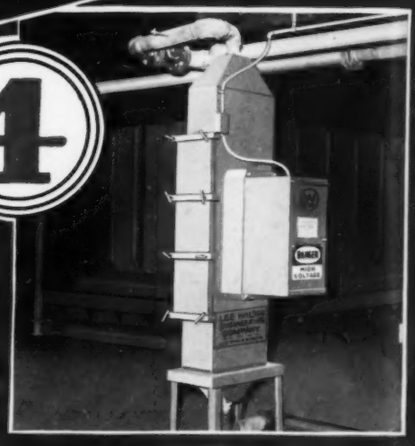
4 Important Reasons Why WILSON Leads



1

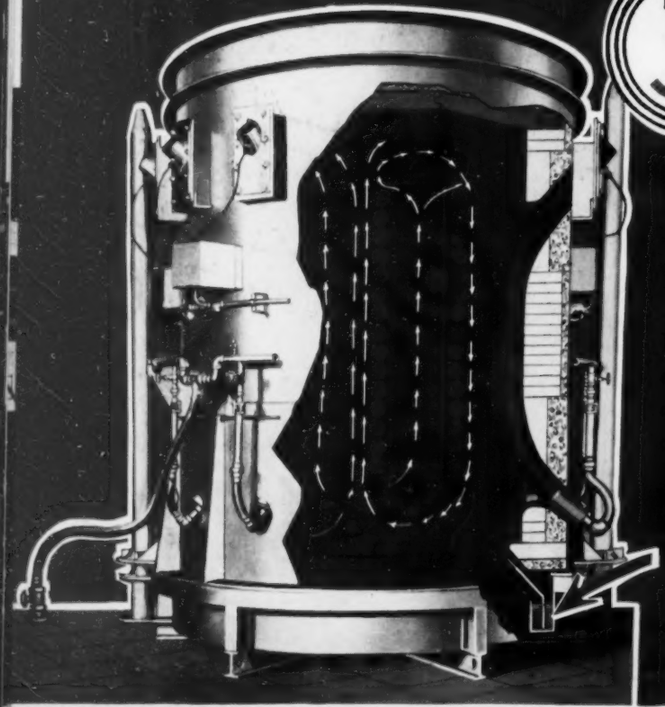
The rectangular portable annealing cover.

400 installations throughout the world.



4

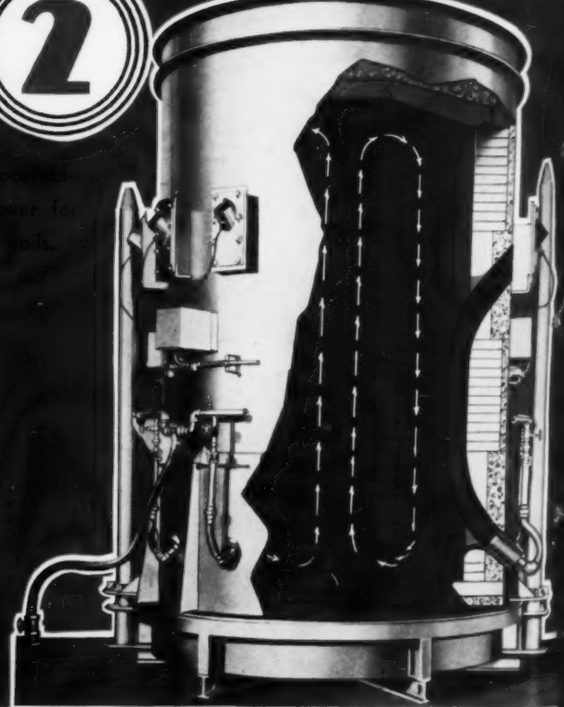
The precipitator type gas cleaner for dirty fuel gas—98% efficient.



3

The circular portable annealing cover for coil and strip stock in multiple stacks.

Forms the liquid seal to give complete bright annealing.



2

The circular portable annealing cover for narrow coils.

Seven Annealing Units covered by U.S. Patents Nos. 1,952,067, 2,063,[illegible], 2,081,612, and other patents pending.

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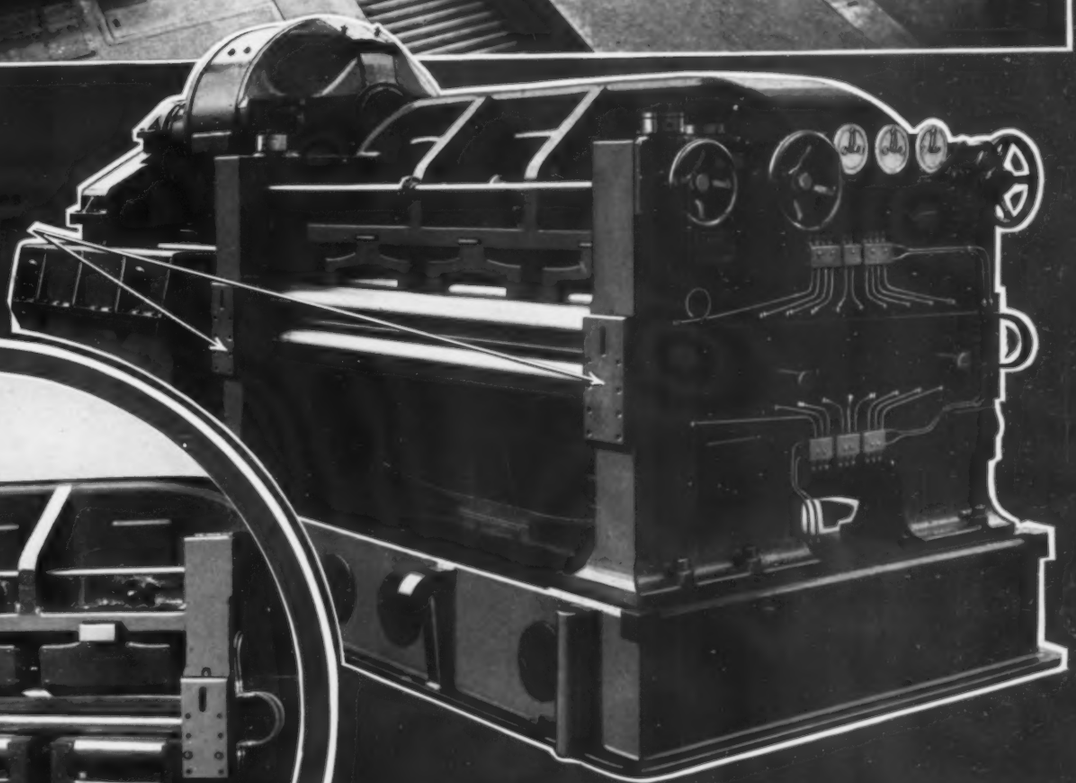

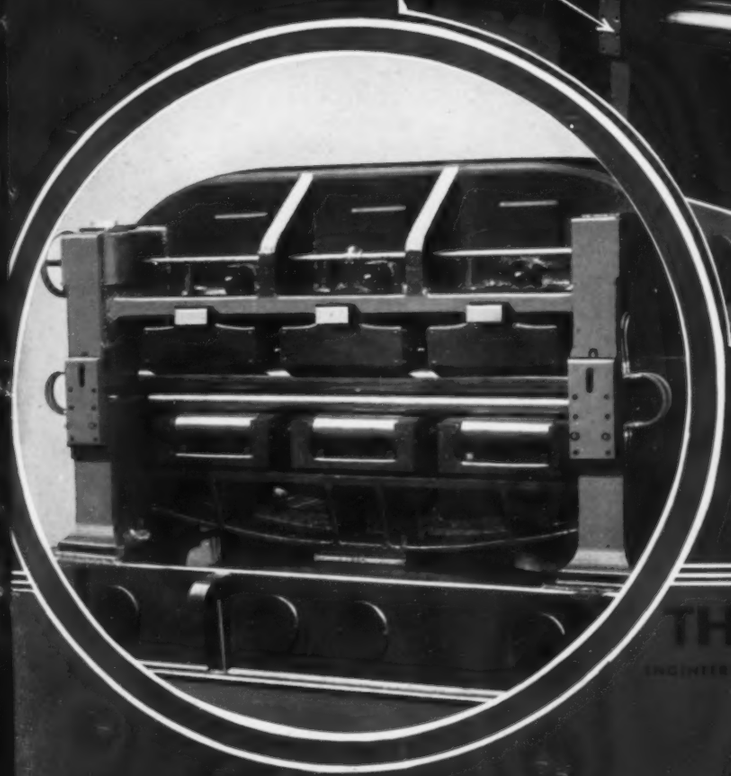

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YOUNGSTOWN, OHIO

ASSOCIATED COMPANY

THE WEAN ENGINEERING CO., Inc. • Warren, Ohio

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LEFT — An installation of Flinn & Dreffein Continuous Heat Treating Furnace in the Continental Steel Company's plant, Canton, Ohio.

BELOW — Flinn & Dreffein Producer Gas Laboratory Type Continuous Billet Heating Furnaces.

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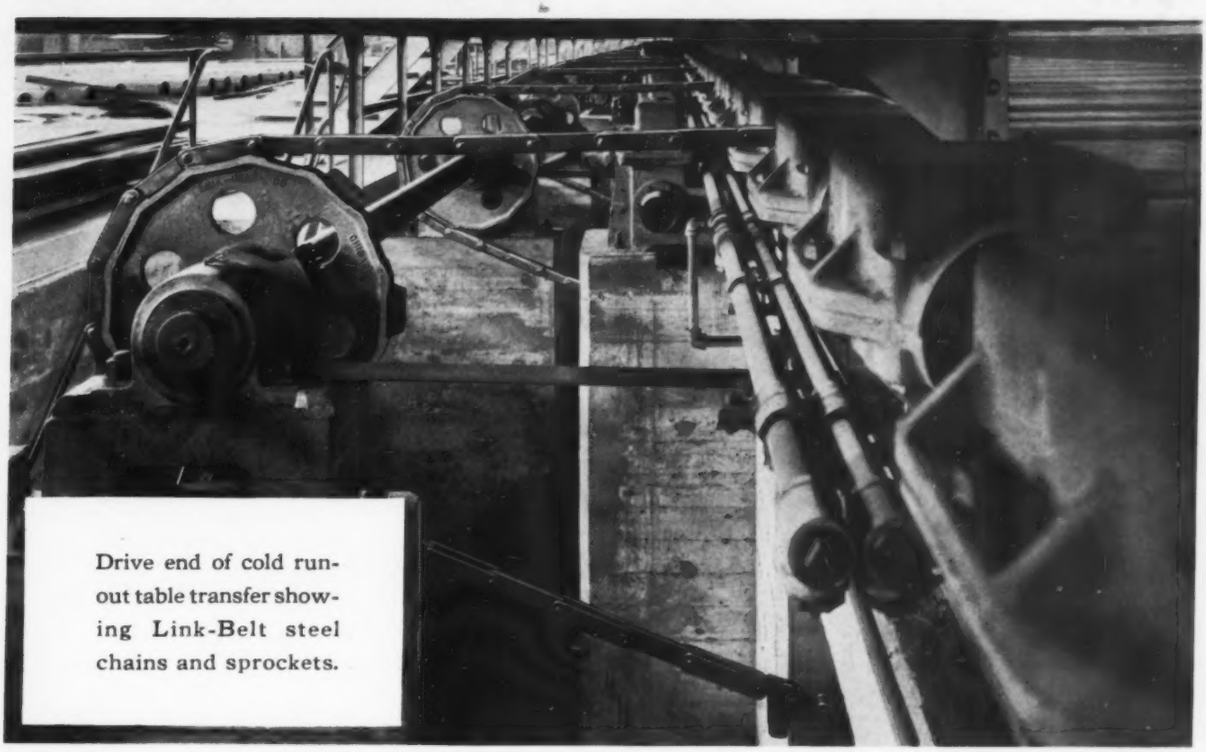
Chains- FOR 98" HOT STRIP MILL



Drive end of cold run-out table transfer showing Link-Belt steel chains and sprockets.

by LINK-BELT

● The transfer table for this 98" continuous hot strip mill furnished by United Engrg. & Foundry Co., is equipped with Link-Belt chains and sprockets. 51 strands of Link-Belt steel chain, 17 each for the hot run table transfer, the hot bed transfer and the cold run table transfer are equipped with non-tilting dogs, tilting dogs and ducking dogs respectively.

Link-Belt—builders of chains since 1875—has perfected an extensive line of chains for transfer tables, coil conveyors, furnace conveyors, feeder and catcher tables, sheet pilers, draw bench and other equipment, as well as a complete line of chains for every power transmission service. Let a Link-Belt steel mill specialist recommend the best chain for your purpose.

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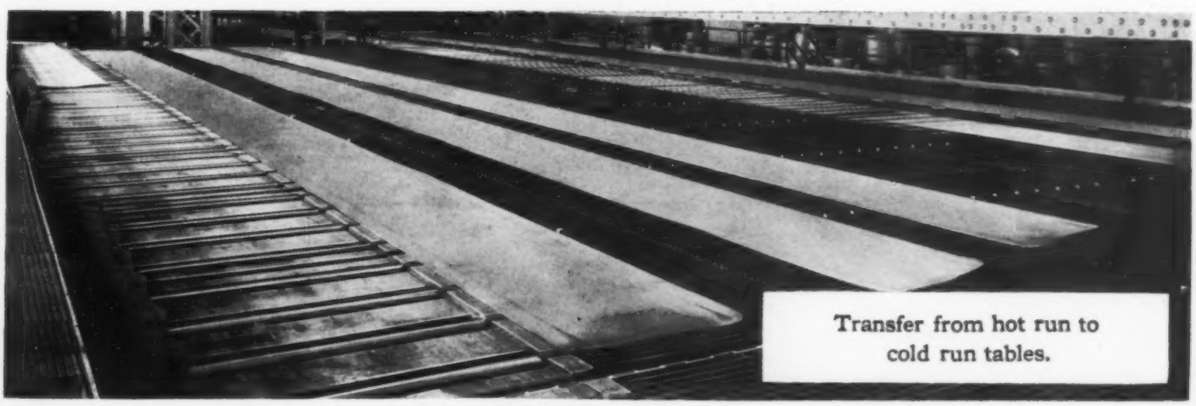
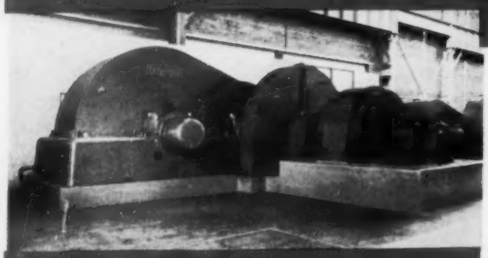


Transfer from hot run to cold run tables.

ALL MILL DRIVES AND PINION STANDS COMPLETELY TIMKEN BEARING EQUIPPED



Timken Bearing Equipped "United" Cold Finishing Mill Drives

Timken Bearing Equipped "United" Pinion Stands

The new "United" 98" Continuous Hot Strip Mill installed at Cleveland, Ohio, affords another notable instance of the increasing swing to TIMKEN Bearings for modern mill drives and pinion stands.

All of the "United" drives and pinion stands through which power is applied to the roughing mill, hot finishing mill, cold finishing mill and skin-pass mill are completely equipped with TIMKEN Bearings.

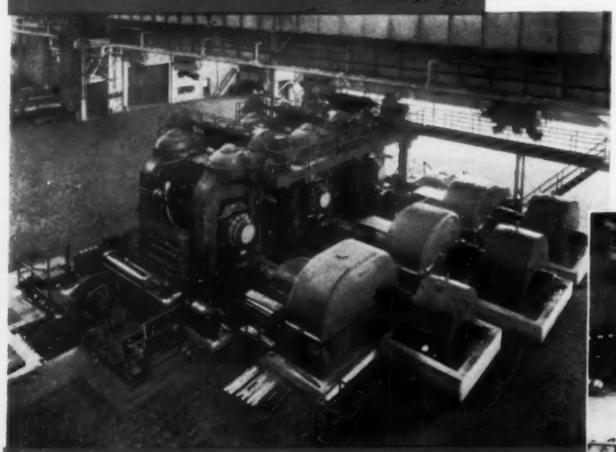
TIMKEN Bearings are also used on all work rolls of this mill, as well as on a large percentage of the auxiliary equipment.

The application of TIMKEN Bearings to the drives and pinion stands of modern rolling mills is of vital importance in view of the tremendous power required to operate these gigantic mills, the high speeds at which they run and the terrific radial, thrust and combined loads which the drive and pinion stand bearings must carry.

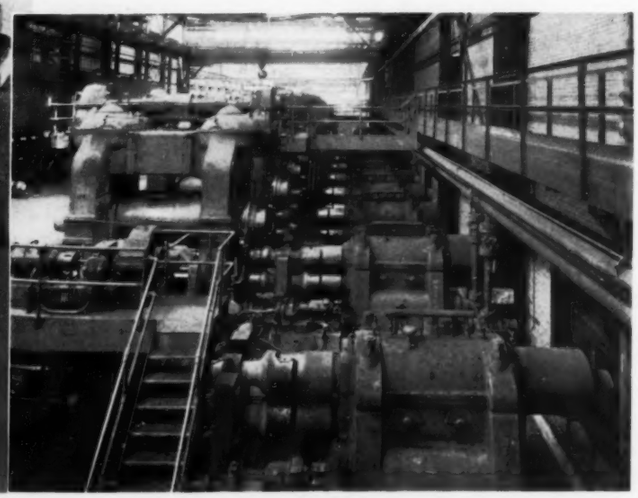
THE TIMKEN ROLLER BEARING CO., CANTON, OHIO

TIMKEN

TAPERED ROLLER BEARINGS

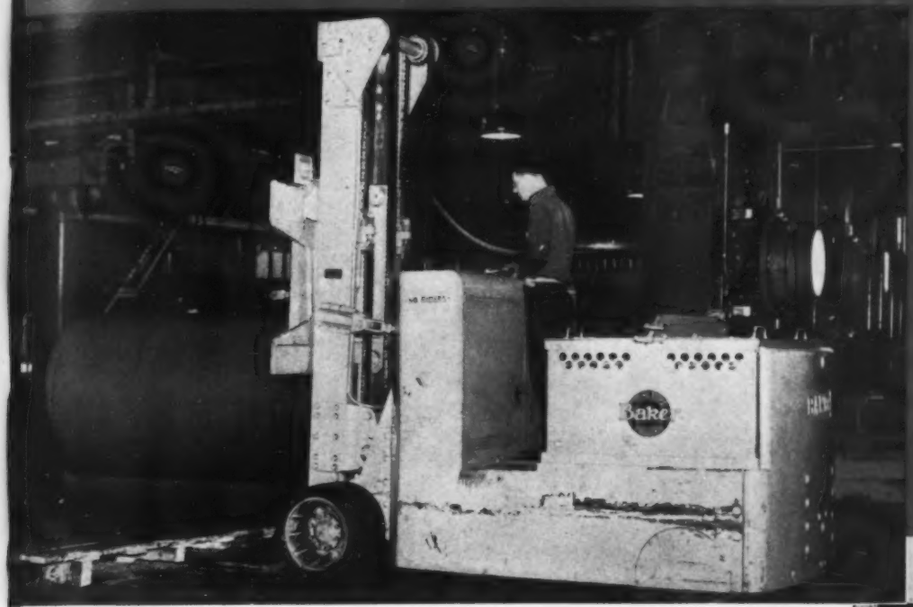


Timken Bearing Equipped "United" Roughing Mill Drives



Timken Bearing Equipped "United" Hot Finishing Mill Drives

THEY'RE BAKERS



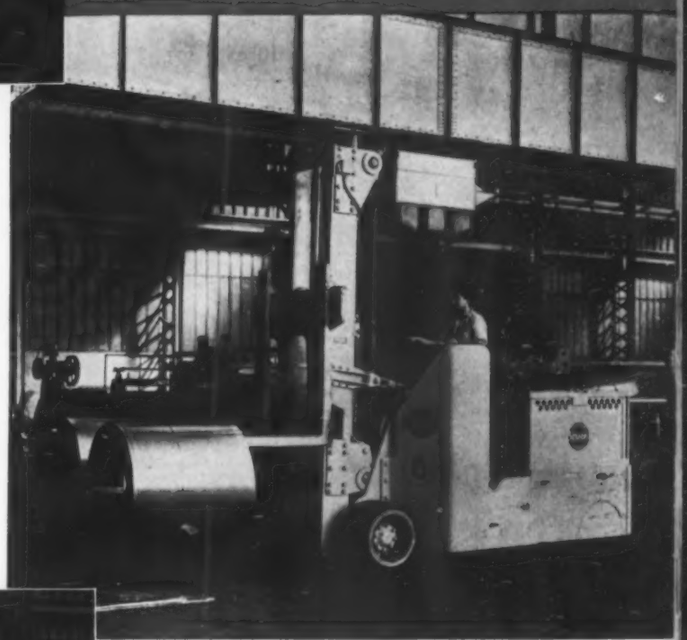
The tractors you'll see at Cleveland handling strip from the world's widest continuous mill . . .

LEFT: Baker Type JO-160, 16,000 pound capacity placing wide coiled strip at the uncoiler of cold reduction mills.

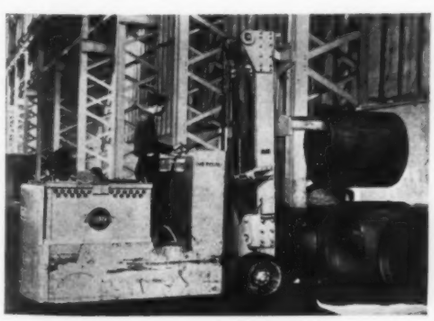
Six Baker center control ram and fork tractors form the coiled strip handling fleet at the "world's widest". A Baker articulated sheet handler of 10 tons capacity loads the packaged sheet into box cars.

The design of these ram tractors incorporates many outstanding improvements such as full contactor control on all motors, automatic acceleration, hydraulic wheel brakes, power steer, anti-plugging protection, straight-line plate frame with forged uprights, strongest drive axle ever used, steering axle designed for minimum tire wear, interchangeable battery boxes and unprecedented accessability to all units.

Baker engineers are at your service to design tractors to meet your requirements. Just write the Baker-Raulang Company, 2162 W. 25th Street, Cleveland, Ohio.



Narrow strip (two coils at one lift) on its way to the shears.



Received from hot mill conveyor, coils are tiered against back wall until needed.

Narrow coils of cold reduced strip, removed from cold mill coiler.

Booths 134-5-6, Iron & Steel Exposition, Sept. 27-30. Visitors are cordially invited to visit our factory.

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Baker
TRADE MARK REG. U.S. PAT. OFF.
OF ELECTRIC VEHICLES

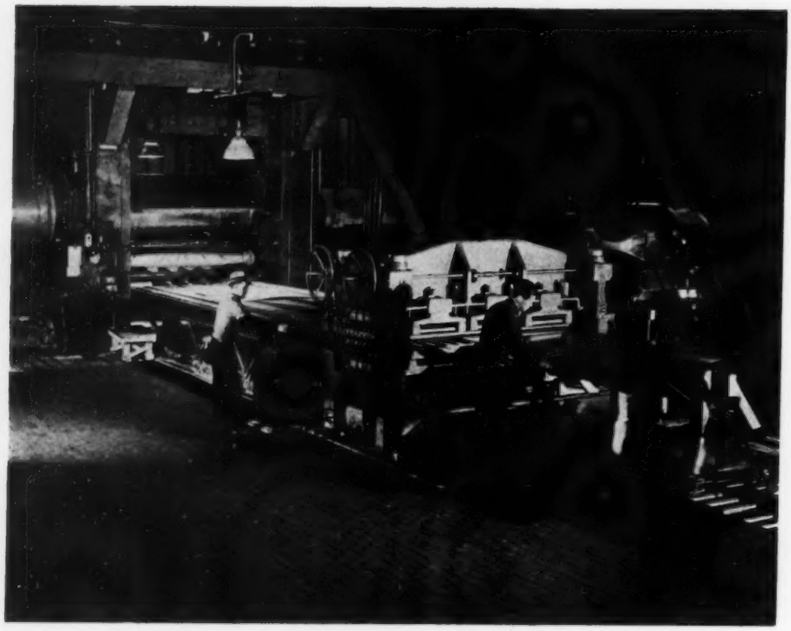
POWER INDUSTRIAL TRUCKS FOR EVERY PURPOSE

AS USUAL

When a bang-up, high grade new mill is featured,
there are found incorporated in it liberal quantities of

"Tool Steel"

Gears, Rolls and other products.



In the largest and fastest
strip mill in the world

616

"TOOL STEEL" ROLLS

were used on

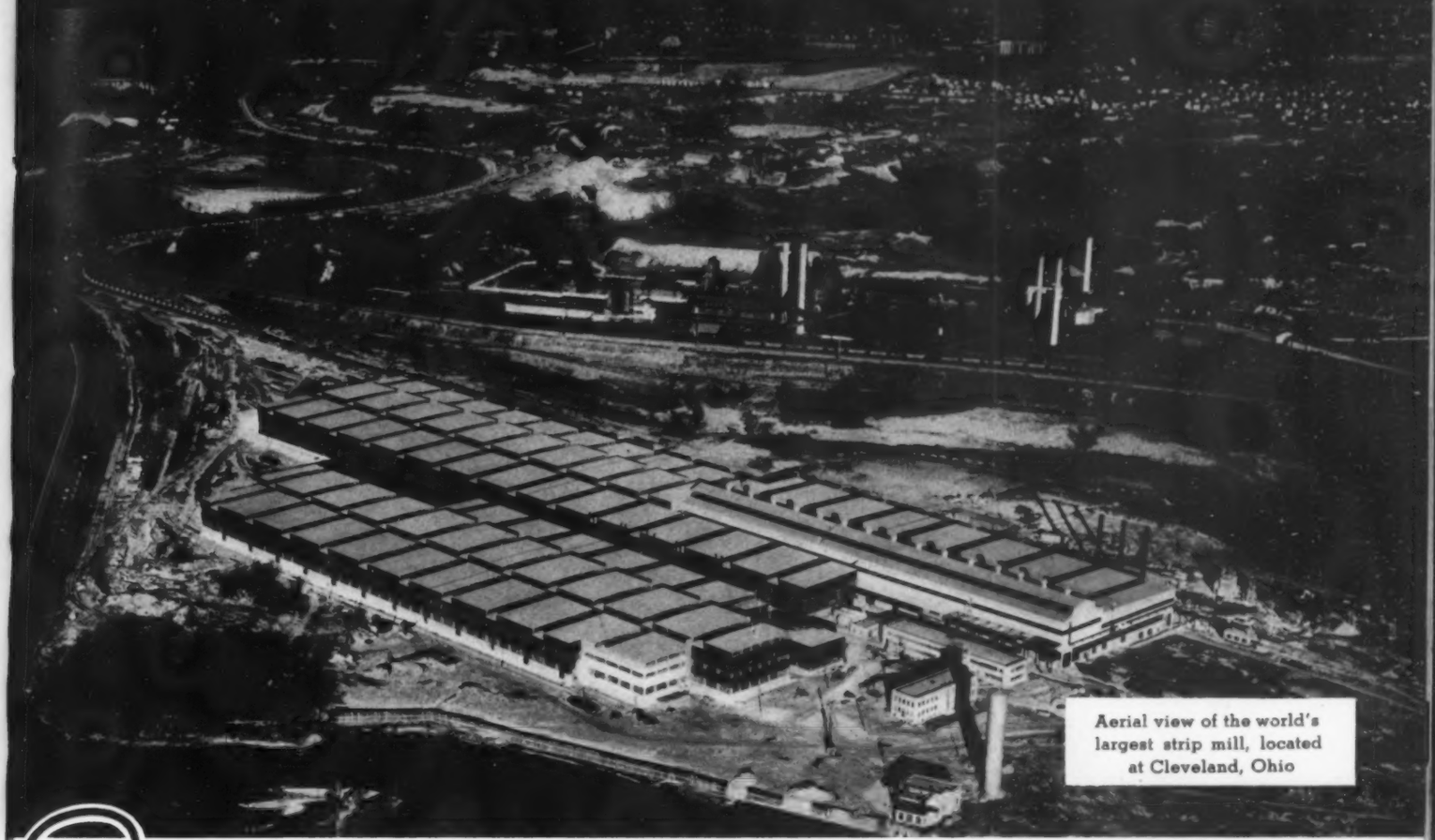
LEVELLERS, COILERS, ETC.

Starting a new mill with rolls of maximum hardness and strength means a longer period before replacements are made and in the meantime—a more perfect product.

THE TOOL STEEL GEAR AND PINION COMPANY

CINCINNATI, OHIO

In the world's largest continuous strip mill of its kind . . .



Aerial view of the world's largest strip mill, located at Cleveland, Ohio

Pennsylvania TRANSFORMERS *faithfully perform their duties*

In steel mills, where continuous processes demand unfailing power supply . . . in iron and steel foundries, where huge electric furnaces turn out tons of special metals . . . in chemical process plants, where the work involves heavy amperes at low voltages . . . in the heavy industries, where welding, heating, annealing or melting is required . . . Pennsylvania can offer you engineering co-operation, furnish the kind of transformers to serve your particular needs most effectively and economically, and guarantee prompt deliveries. The largest industrials use Pennsylvania Transformers!

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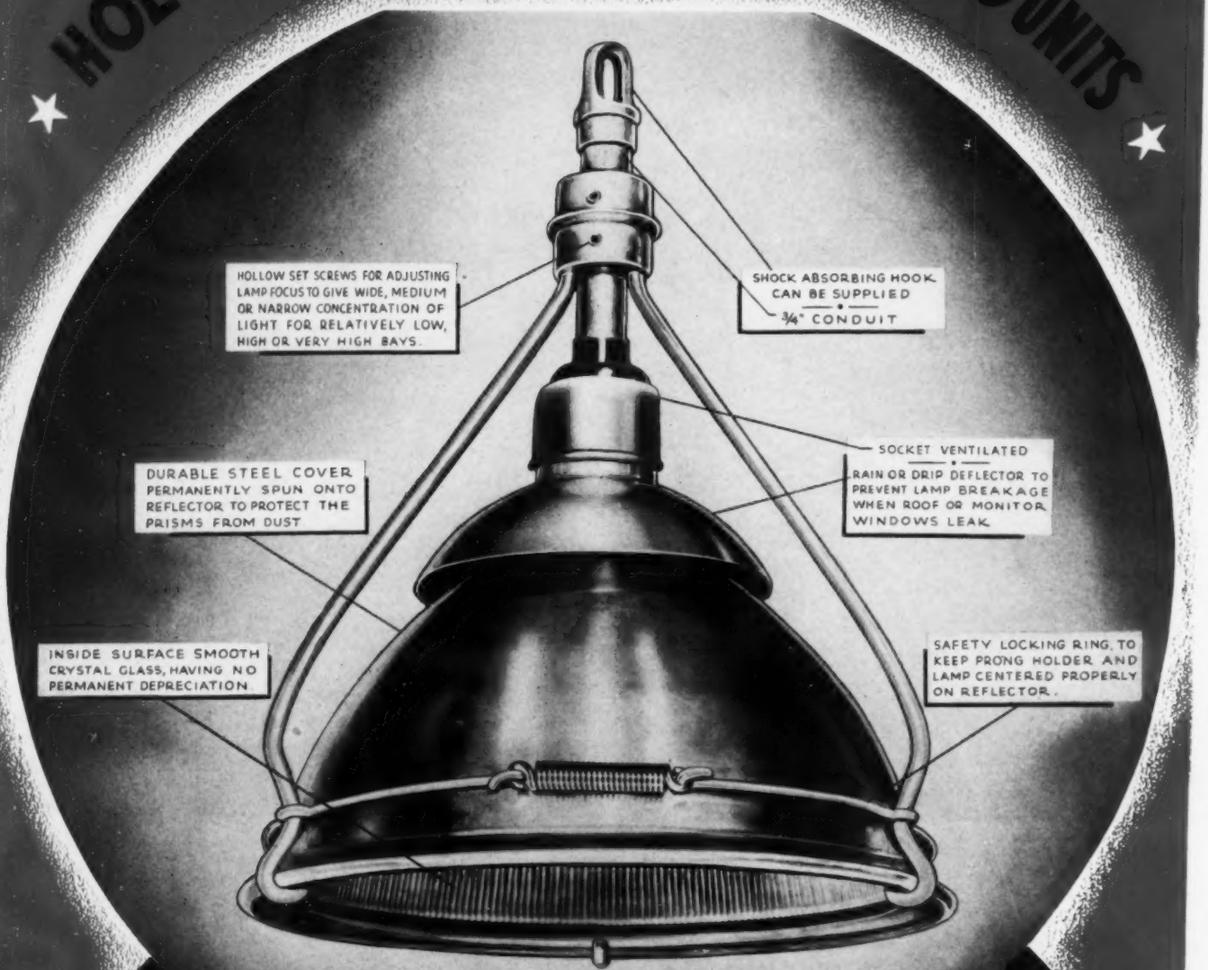
HOLLOW SET SCREWS FOR ADJUSTING LAMP FOCUS TO GIVE WIDE, MEDIUM OR NARROW CONCENTRATION OF LIGHT FOR RELATIVELY LOW, HIGH OR VERY HIGH BAYS.
SHOCK ABSORBING HOOK. CAN BE SUPPLIED ¾" CONDUIT
SOCKET VENTILATED RAIN OR DRIP DEFLECTOR TO PREVENT LAMP BREAKAGE WHEN ROOF OR MONITOR WINDOWS LEAK.
DURABLE STEEL COVER PERMANENTLY SPUN ONTO REFLECTOR TO PROTECT THE PRISMS FROM DUST
INSIDE SURFACE SMOOTH CRYSTAL GLASS, HAVING NO PERMANENT DEPRECIATION
SAFETY LOCKING RING, TO KEEP PRONG HOLDER AND LAMP CENTERED PROPERLY ON REFLECTOR.

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"National" Carbon Brushes are developed and applied by a technical staff, schooled through broad experience to deal successfully with problems of commutation and brush application. They have developed dependable brush grades for every class of service.

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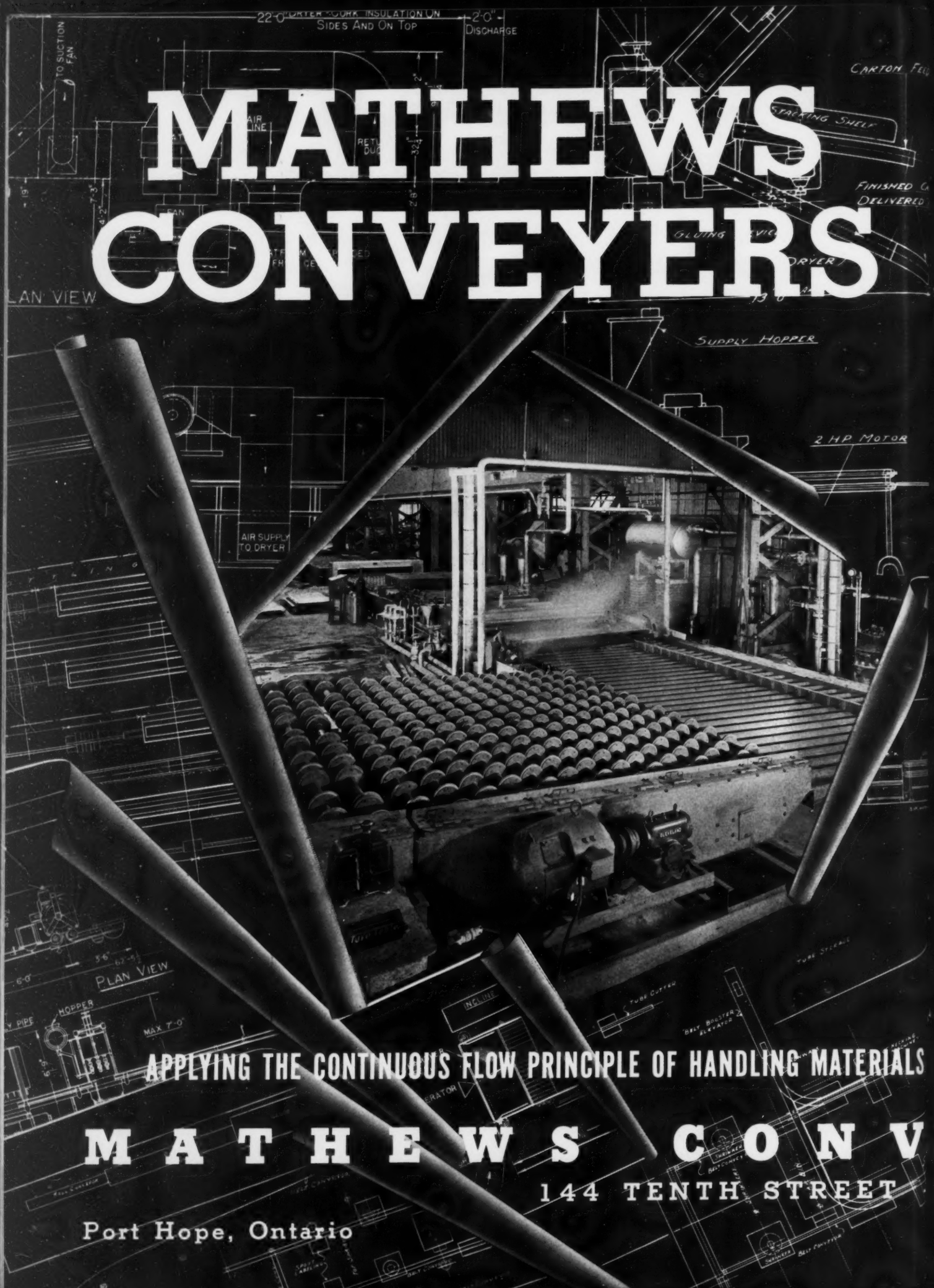

APPLYING THE CONTINUOUS FLOW PRINCIPLE OF HANDLING MATERIALS

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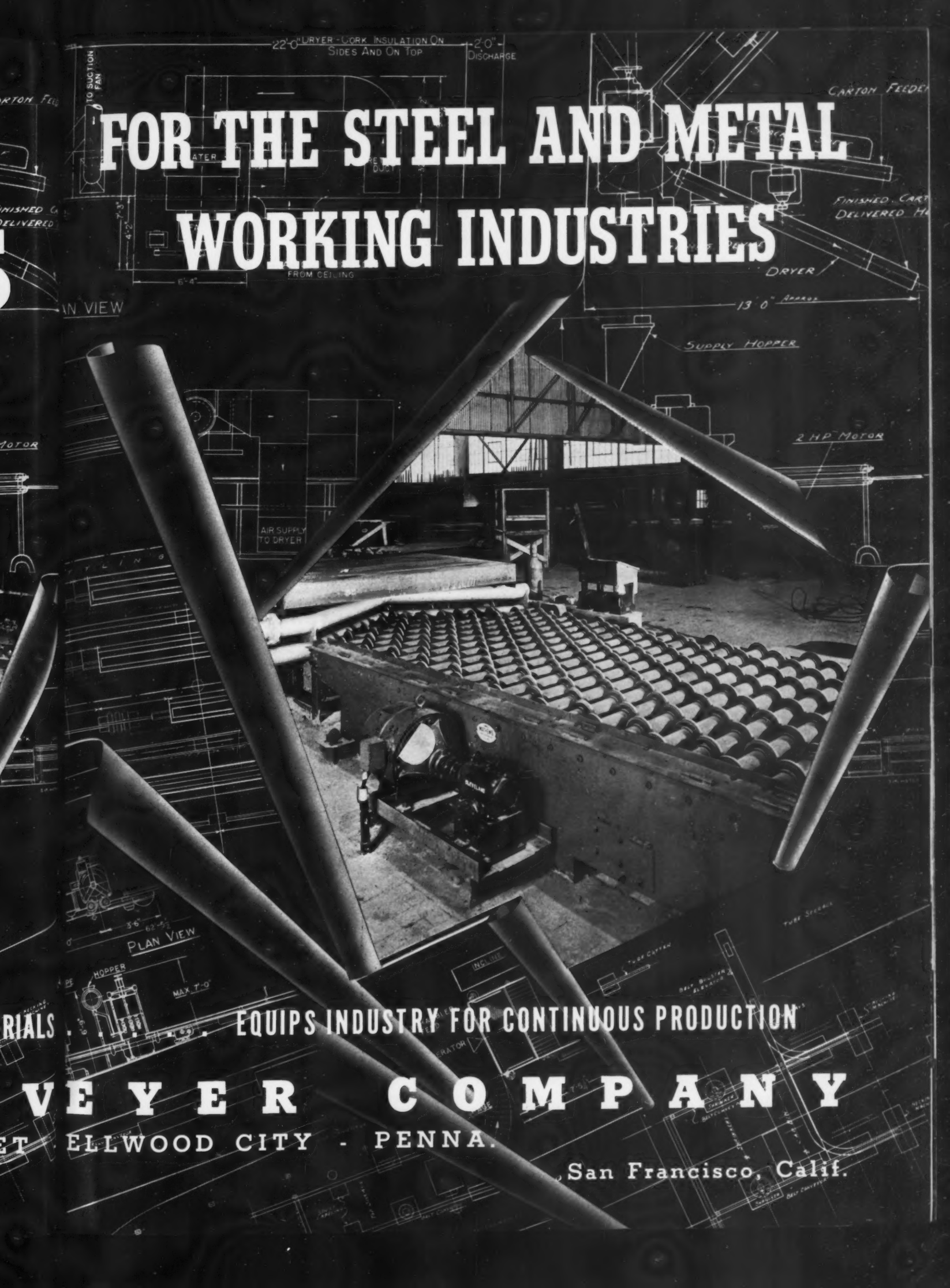
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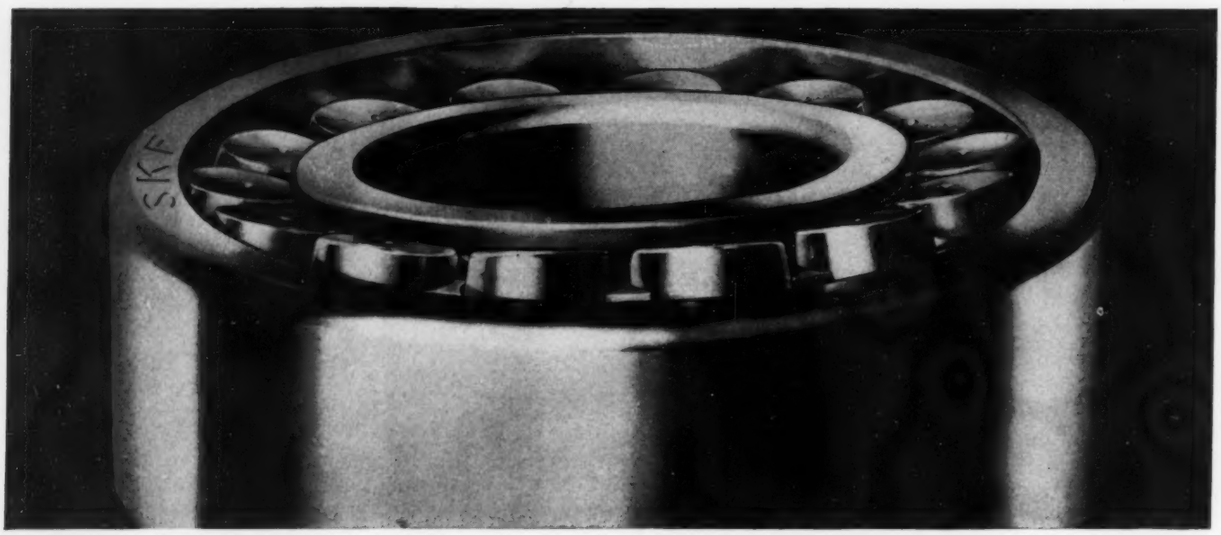
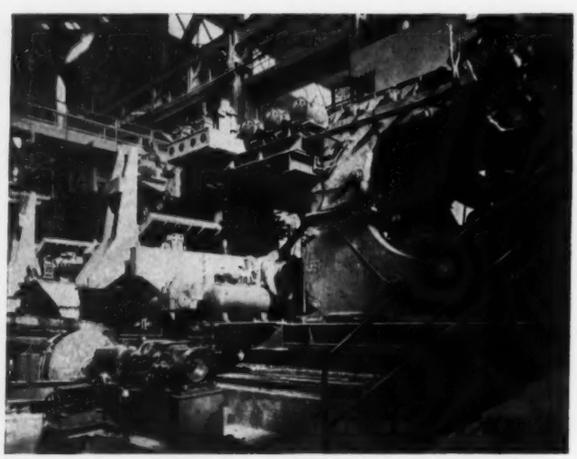
The BEARING *that* TOUGH JOBS *have made* FAMOUS





● *Tension rolls of large coilers, made by United Engineering & Foundry Co. for a 98" mill, more on SKF Sperical Roller Bearings.*

It's on the giant coilers of the World's largest strip mill

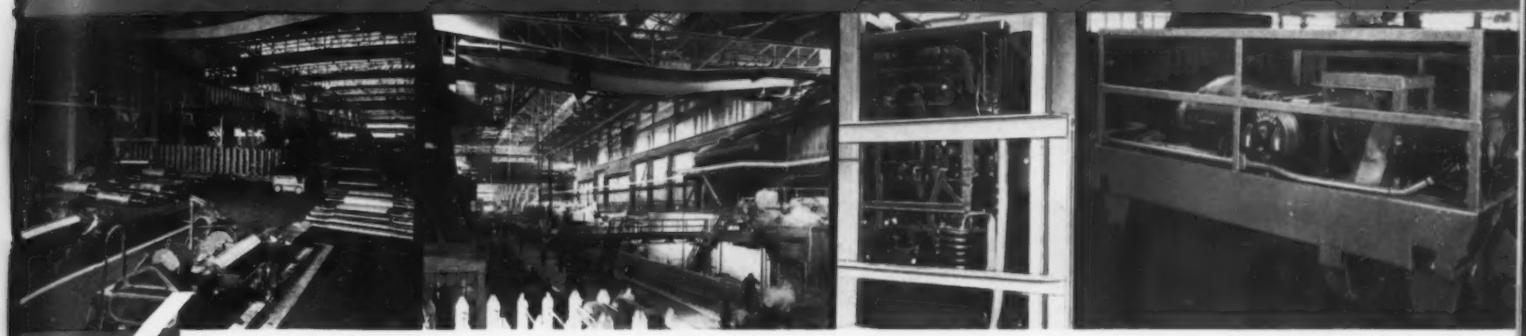
Here's one bearing you'll always find on a tough job. It's an SKF Spherical Roller Bearing.

Whether it's taking the tremendous loads imposed on back-uprolls . . . assuring perfect alignment on big gear reduction drives . . . or keeping rotating parts of coilers moving freely, it "takes it". That's why well-informed steel men everywhere say, "If it's a tough job, it's an SKF job."

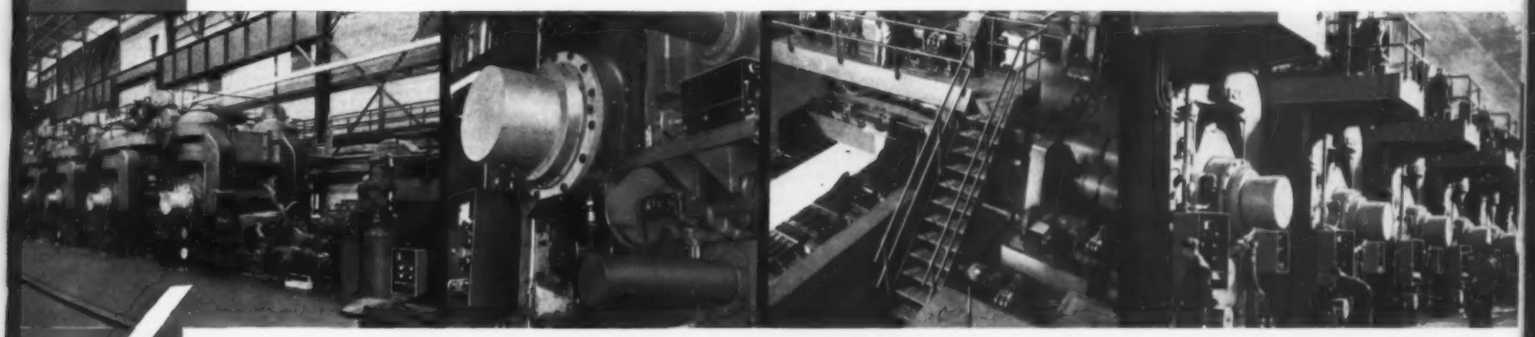
Self-aligning, self-contained, the SKF Spherical Roller Bearing assures an equalized load distribution insuring full bearing capacity and long life. No wonder it's the first choice of men who want a "tough job" bearing. SKF Industries, Inc., Front St. & Erie Ave., Phila., Pa. 4186

SKF
Roller Bearings

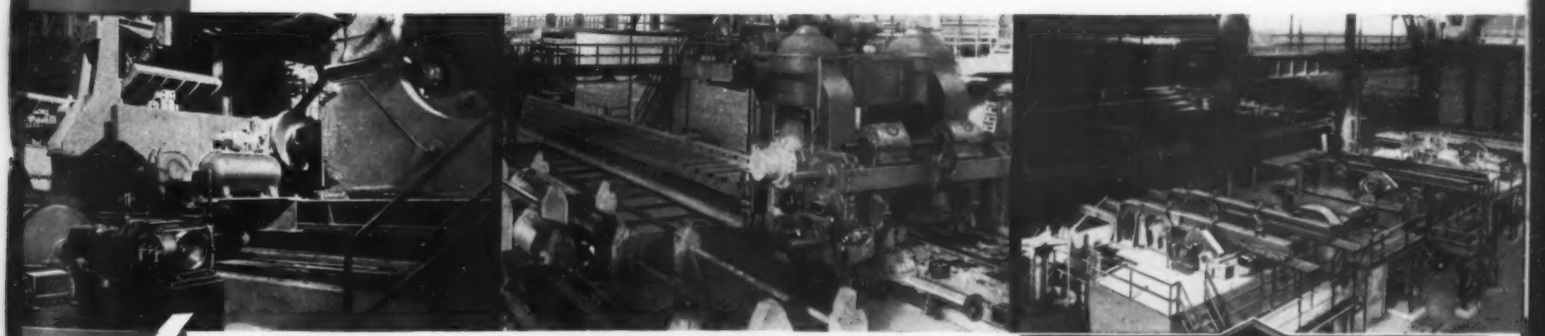
Cutler-Hammer Control and Brakes Play an Important Part in the World's Largest and Most Modern Continuous Strip Mill!



All cranes in this mill are equipped with CUTLER-HAMMER Control, DUR-ristors, Safety Limit Stops and Type M Brakes.



Each roll stand in both the hot and cold strip mills is equipped with C-H Screwdown Control, Magnetic Brakes, Magnetic Clutches, and Limit Switches.



At the Steel Show—Look for Cutler-Hammer Exhibition Booths

where the complete line of C-H equipment for steel mills is on display. CUTLER-HAMMER, Inc., *Pioneer Electrical Manufacturers,* 1269 St. Paul Avenue, Milwaukee, Wisconsin.

44
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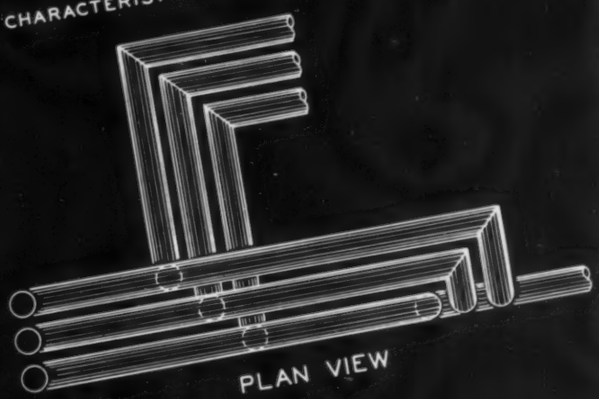
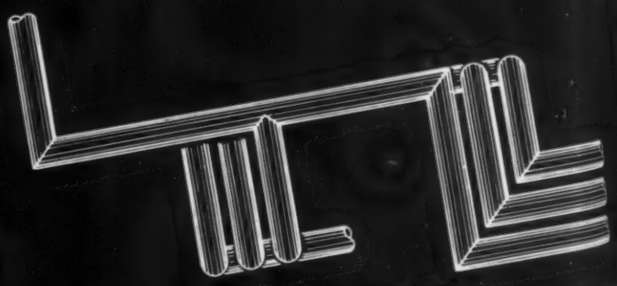
CUTLER-HAMMER
MOTOR CONTROL
C-H

SOUND in design— FLEXIBLE in application

CHARACTERISTIC GENERAL ARRANGEMENT

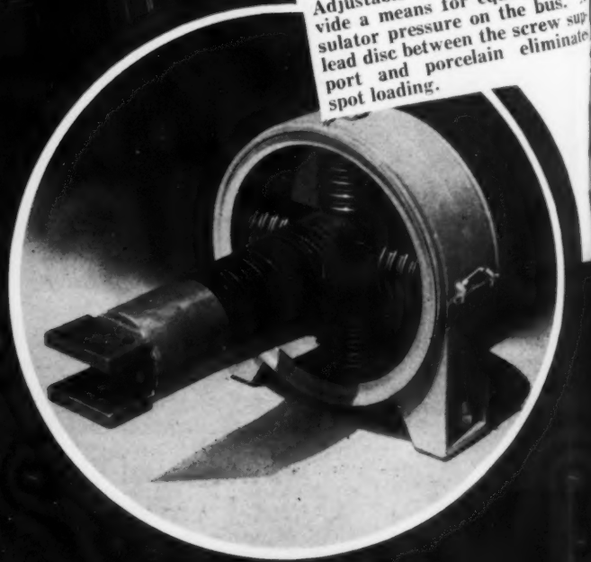


PLAN VIEW



SIDE ELEVATION

R&IE METALAIR insulating support assembly. Note that insulators are subjected to compression strains only, regardless of type or direction of loading. Adjustable screw supports provide a means for equalizing insulator pressure on the bus. A lead disc between the screw support and porcelain eliminates spot loading.



Synchronizing Bus—with disconnecting switches above the bus and bus risers in the rear. Provision is made for extension of buses in the foreground. Note minimum space required.

• featuring

R&IE *Custom-Made*

METALAIR

Bus Structures

SEGREGATED CONDUCTORS eliminate all danger of interphase short circuits.

PORCELAIN INSULATION is more reliable and has more permanence than organic materials.

PORCELAIN IN COMPRESSION ONLY gives maximum strength and dependability against stresses.

COVERS ARE READILY REMOVABLE for inspection and cleaning.

ALL STRAINS ARE TAKEN BY INSULATOR SUPPORTS. Covers are not stress members and can be entirely removed without affecting ability to withstand strains.

MINIMUM ERECTION COST is made possible by practical design and skilled workmanship.

FLEXIBLE IN APPLICATION to any existing station arrangement.

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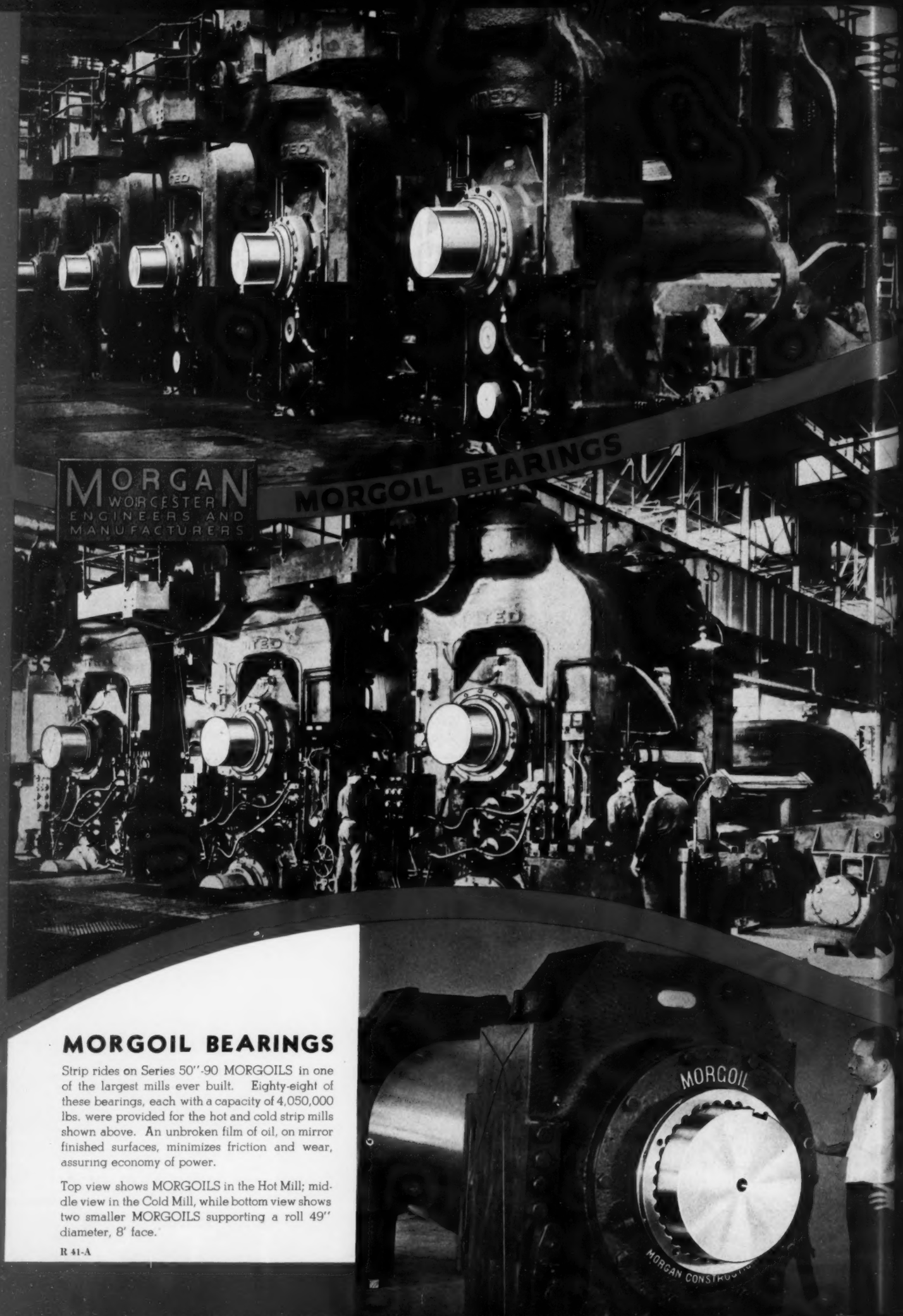
TYPICAL SECTIONS
· of ·
METALAIR BUS STRUCTURES
will be shown at the
IRON *and* STEEL EXPOSITION
SEPT., 27, 28, 29, 30
•
Cleveland Auditorium

Feeder buses—showing horizontal arrangement and group feeder disconnecting switches mounted above the metal inclosure for the connection between the feeder buses and the main buses, located on the floor below, is shown in the third bay.

—RELIABILITY·



MORGOIL BEARINGS

Strip rides on Series 50"-90 MORGOILS in one of the largest mills ever built. Eighty-eight of these bearings, each with a capacity of 4,050,000 lbs. were provided for the hot and cold strip mills shown above. An unbroken film of oil, on mirror finished surfaces, minimizes friction and wear, assuring economy of power.

Top view shows MORGOILS in the Hot Mill; middle view in the Cold Mill, while bottom view shows two smaller MORGOILS supporting a roll 49" diameter, 8' face.

R 41-A

An Eye on the Future

In design and construction of complete Morgan Continuous Rolling Mills, Morgan engineers look at the present with an eye to the future. Morgan Mills have always been built to meet the exacting demands of current production specifications and to set up new standards for the changing requirements of the future.

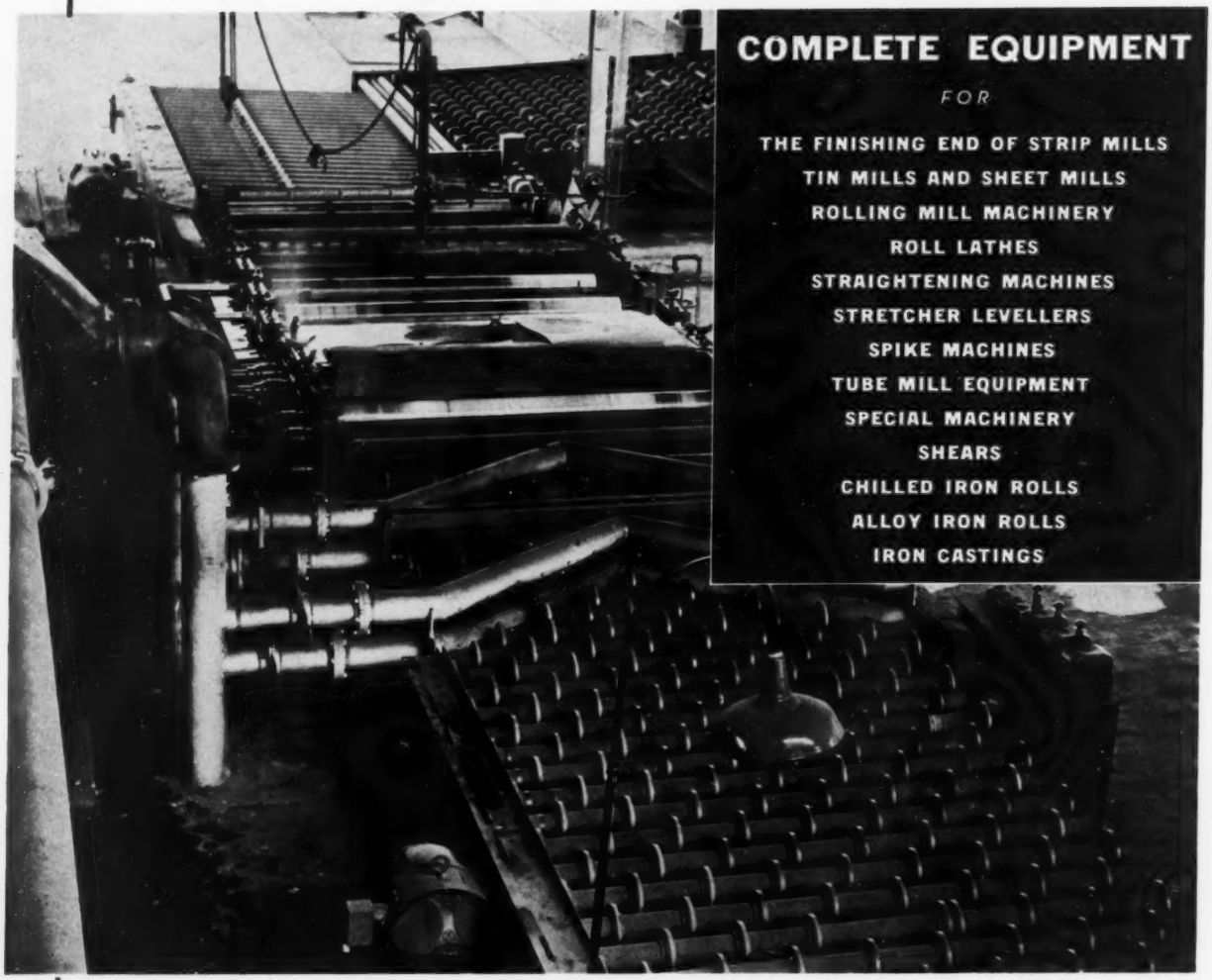
TOP: Four Strand Mechanical Billet Switch.

CENTER: General view of a recent Morgan installation showing Looping Stands, and Repeater that feeds Rod Finishing Train.

BOTTOM: Double Carryover Cooling Bed passing bars in perfectly straight lengths and with ends remarkably even.

Cleaning and Scrubbing Line

for the WORLD'S LARGEST STRIP MILL



COMPLETE EQUIPMENT

FOR

THE FINISHING END OF STRIP MILLS
TIN MILLS AND SHEET MILLS
ROLLING MILL MACHINERY
ROLL LATHES
STRAIGHTENING MACHINES
STRETCHER LEVELLERS
SPIKE MACHINES
TUBE MILL EQUIPMENT
SPECIAL MACHINERY
SHEARS
CHILLED IRON ROLLS
ALLOY IRON ROLLS
IRON CASTINGS

View from discharge end of scrubbing and cleaning line. This equipment can be used for "bright" pickling, for scrubbing and drying previously wet pickled sheets, for cleaning, scrubbing and drying hot rolled sheets either in the "as rolled" state, or in a pickled normalized or annealed condition, or for de-oiling and degreeing sheets.

Designed and Built by

THE YOUNGSTOWN FOUNDRY & MACHINE CO.

YOUNGSTOWN, OHIO

FIFTY-TWO YEARS OF SERVICE TO THE IRON & STEEL INDUSTRY

FLEXIBLE COUPLINGS by

FLEXIBLE COUPLING
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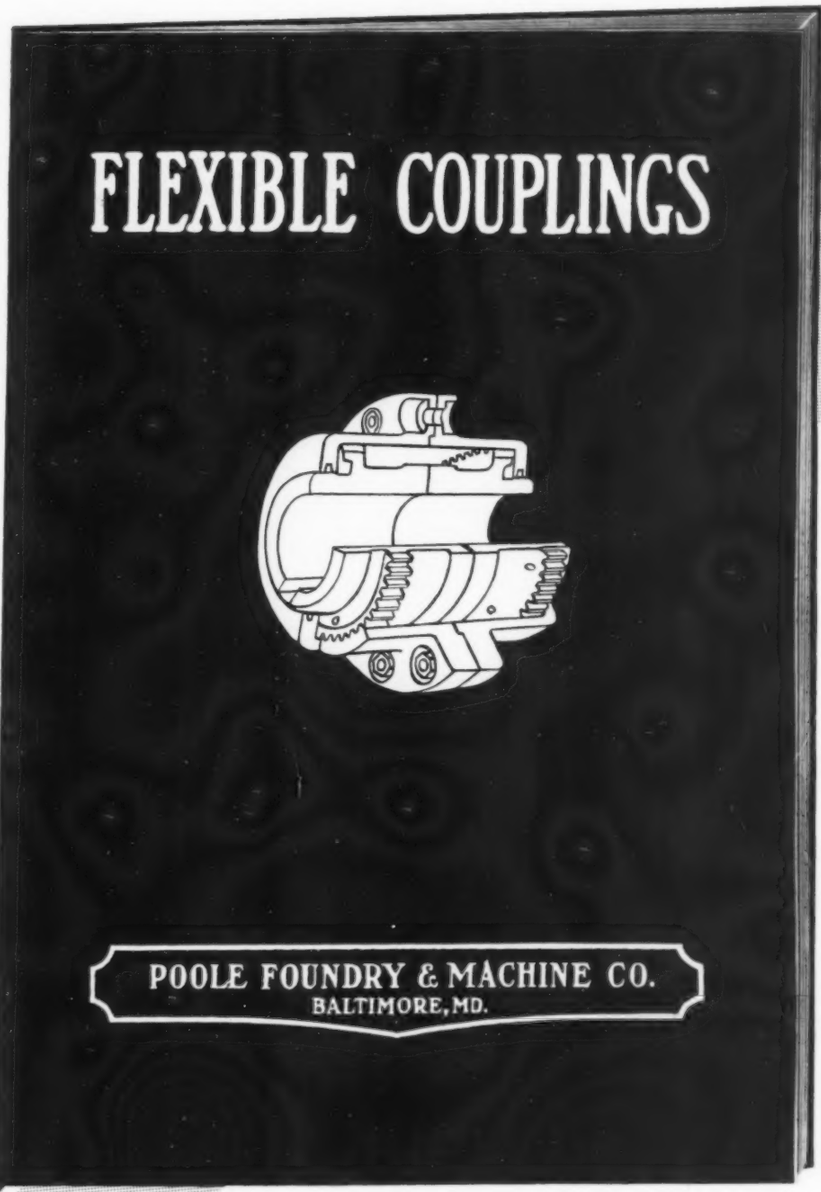

This catalog supersedes all previous issues and the valuable information which we have compiled, pertaining to flexible couplings of our manufacture, embodies data, tables and information that has not yet been presented in any catalogs of this nature.

It has been our endeavor to increase the value and scope of the information, which we have published.

We are confident this catalog will be a valuable reference book to all users of flexible couplings and engineers specifying such equipment.

Send for YOUR Copy Now

POOLE FOUNDRY & MACHINE CO.

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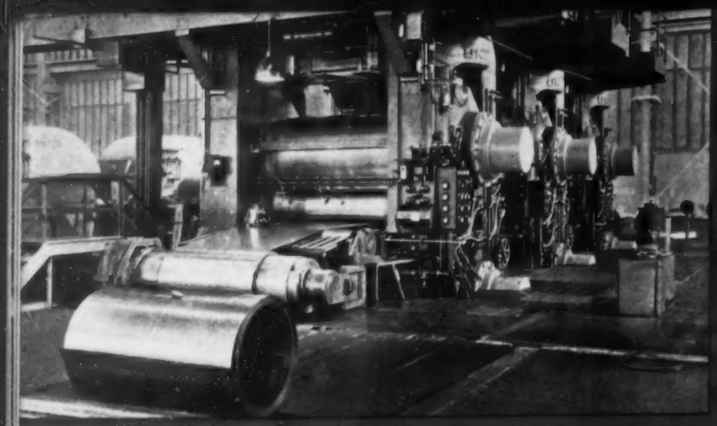
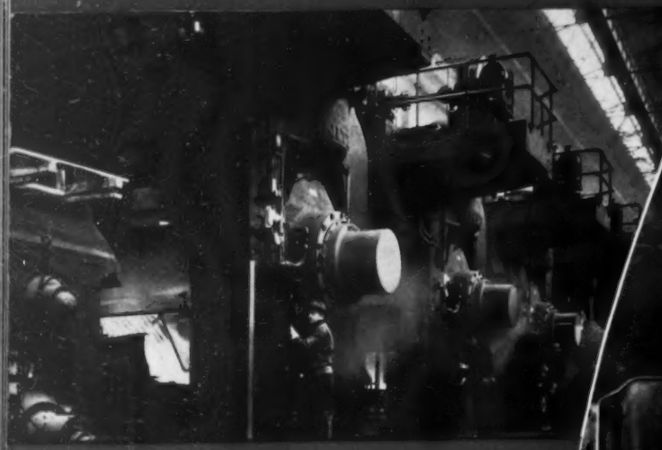
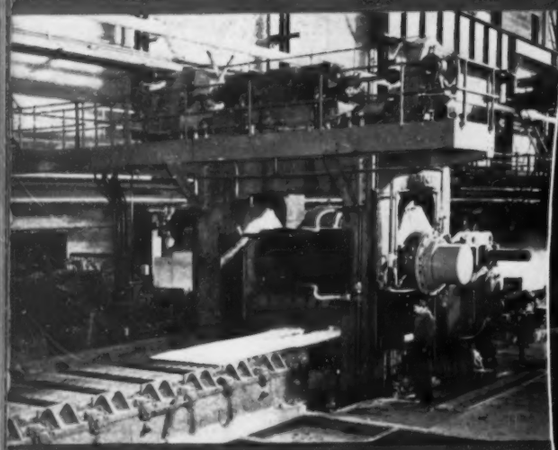
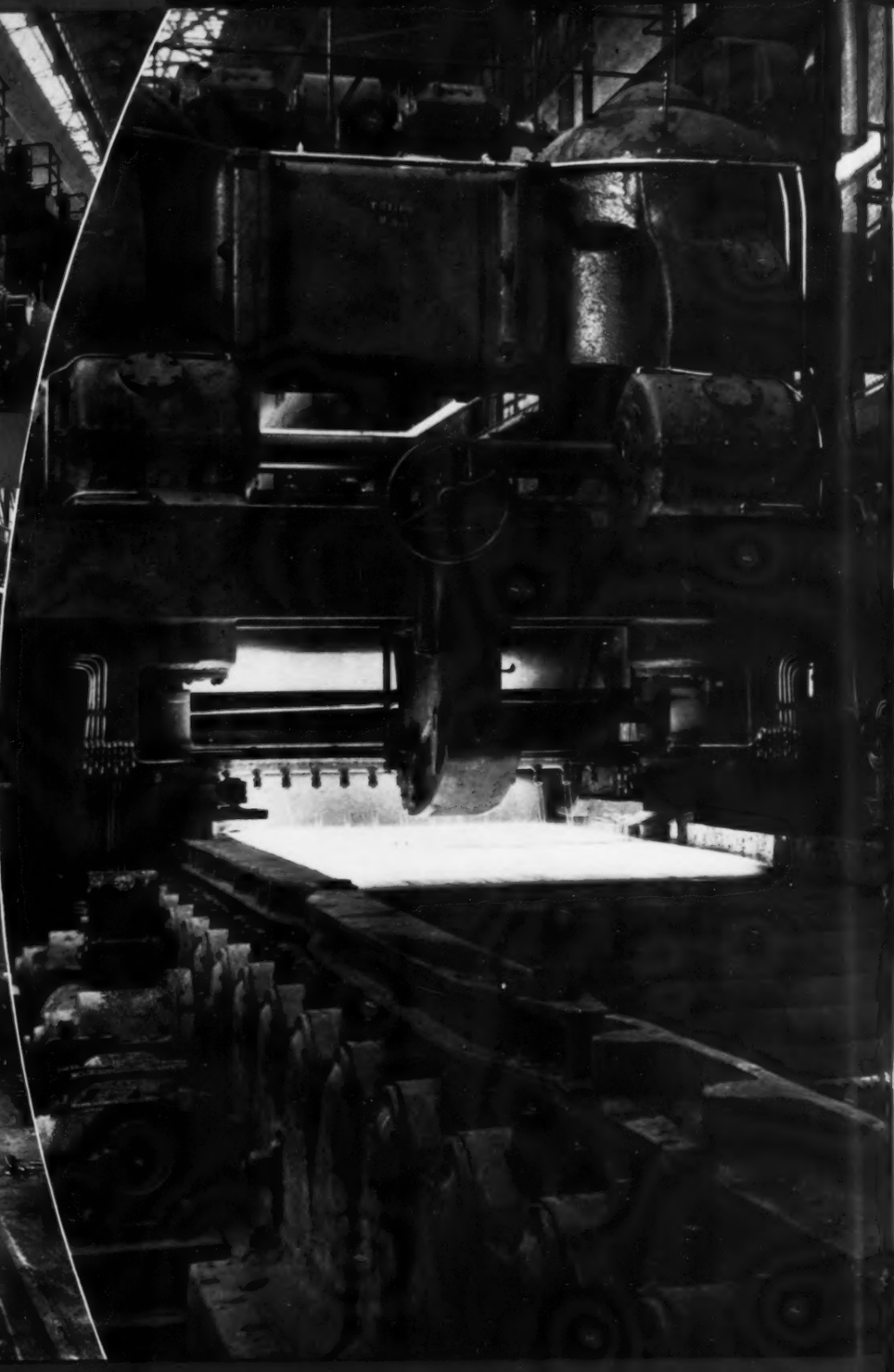


POOLE

AT THE WORLD'S LA







flexible COUPLINGS

D'S LARGEST STRIP MILL

- NO WELDED PARTS
- OIL PROOF—DUST PROOF
- ALL METAL FORGED STEEL
- FULLY LUBRICATED

It gives full compensation for the unavoidable errors in alignment or those caused by changes of temperature, wear of bearings, vibration, etc. It also permits free lateral float to connected shafts, and prevents torsional motions. Stronger than the connecting shafts. Capable of sudden reversals at high speed or heavy duty, slow speed drives without strain to the coupling or the machinery it connects. Simple in design, no springs, pins or bushings, self-aligning, silent and vibrationless at all times.

VISIT OUR EXHIBIT—BOOTH 42—IRON AND STEEL EXPOSITION

POOLE FOUNDRY & MACHINE COMPANY

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FLEXIBLE COUPLINGS *by*

POOLE PRODUCTS

FLEXIBLE COUPLINGS
SPEED INCREASING OR DECREASING GEARS
MACHINE MOULDED AND CUT GEARS

GREY IRON AND SEMI STEEL CASTINGS
SPECIAL MACHINERY TO ENGINEERS' DRAWINGS AND SPECIFICATIONS

NEW MODERN DAYLIGHT PLANT WHERE POOLE COUPLINGS ARE MADE

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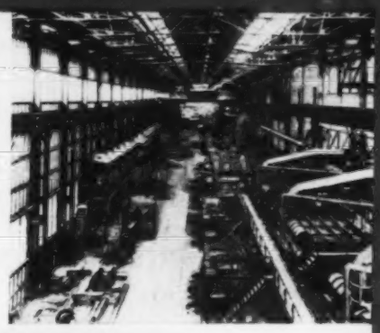
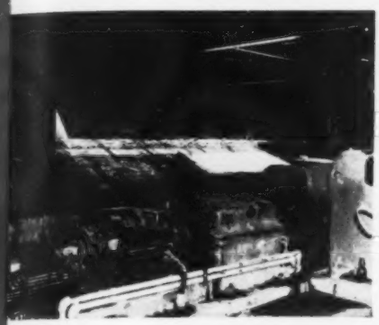
BALTIMORE, MARYLAND

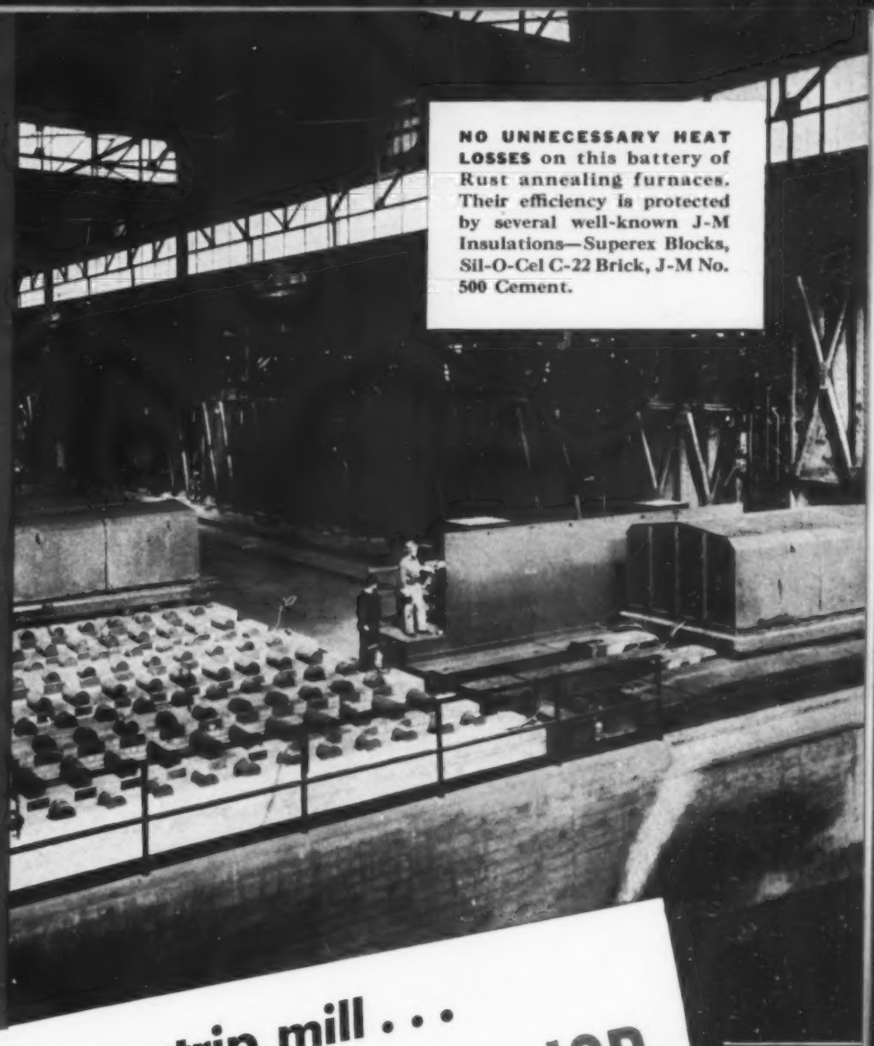


J-M SUPEREX BLOCKS . . . the most widely used block insulation for temperatures up to 1900° F. . . . reduce heat loss through arches and sidewalls of these Rust slab-heating furnaces. J-M No. 500 Cement, Sil-O-Cel Natural Brick and Sil-O-Cel C-22 Brick are also used here.



DISCHARGE END of slab-heating furnaces in this up-to-date 98" continuous-strip mill. Doors are of J-M Sil-O-Cel C-3 Concrete. Hearths in primary zone are insulated with Sil-O-Cel Natural Brick . . . in secondary zone, with Sil-O-Cel C-22 Brick.

STEAM LINES are insulated with J-M 85% Magnesia Pipe Covering . . . on outdoor runs weatherproofed with J-M Double-Coated Flexstone. Throughout the plant, more than 8,000 feet of piping are insulated in this way.



NO UNNECESSARY HEAT LOSSES on this battery of Rust annealing furnaces. Their efficiency is protected by several well-known J-M Insulations—Superex Blocks, Sil-O-Cel C-22 Brick, J-M No. 500 Cement.

In the world's widest strip mill . . .

J-M INSULATIONS KEEP HEAT on the JOB

. . . provide sure protection against excessive fuel costs

HEAT works at maximum efficiency in the new 98" continuous-strip mill at Cleveland, O. For, throughout this plant, J-M Insulations provide an ever-dependable barrier against costly heat losses . . . keep fuel bills at minimum figures.

Here, seven different J-M materials are on the job. Products of more than 80 years of intensive research and field experience, there is a J-M Insulation for every steel-mill service. And on hundreds of important installations all over the United States, they are serving efficiently, dependably, in the control of heat waste.

For complete information on the full line of J-M Insulations, write for catalog IN-55A. Johns-Manville, 22 East 40th Street, New York City.

JOHNS-MANVILLE JOHNS-MANVILLE JM PRODUCTS **INDUSTRIAL INSULATIONS**

PORCELAIN ENAMELED STEEL REFLECTORS

MEET US AT THE CLEVELAND PUBLIC AUDITORIUM
SEPT. 27-30 • BOOTH No. 16

USED IN WORLD'S LARGEST COLD STRIP MILL AT CLEVELAND

This company chose this Ivanhoe Steel Porcelain Enameled Mercury Lamp Reflector for exactly the same reasons that give it a powerful appeal to any steel manufacturer interested in good lighting at mounting heights of 25 feet or more.

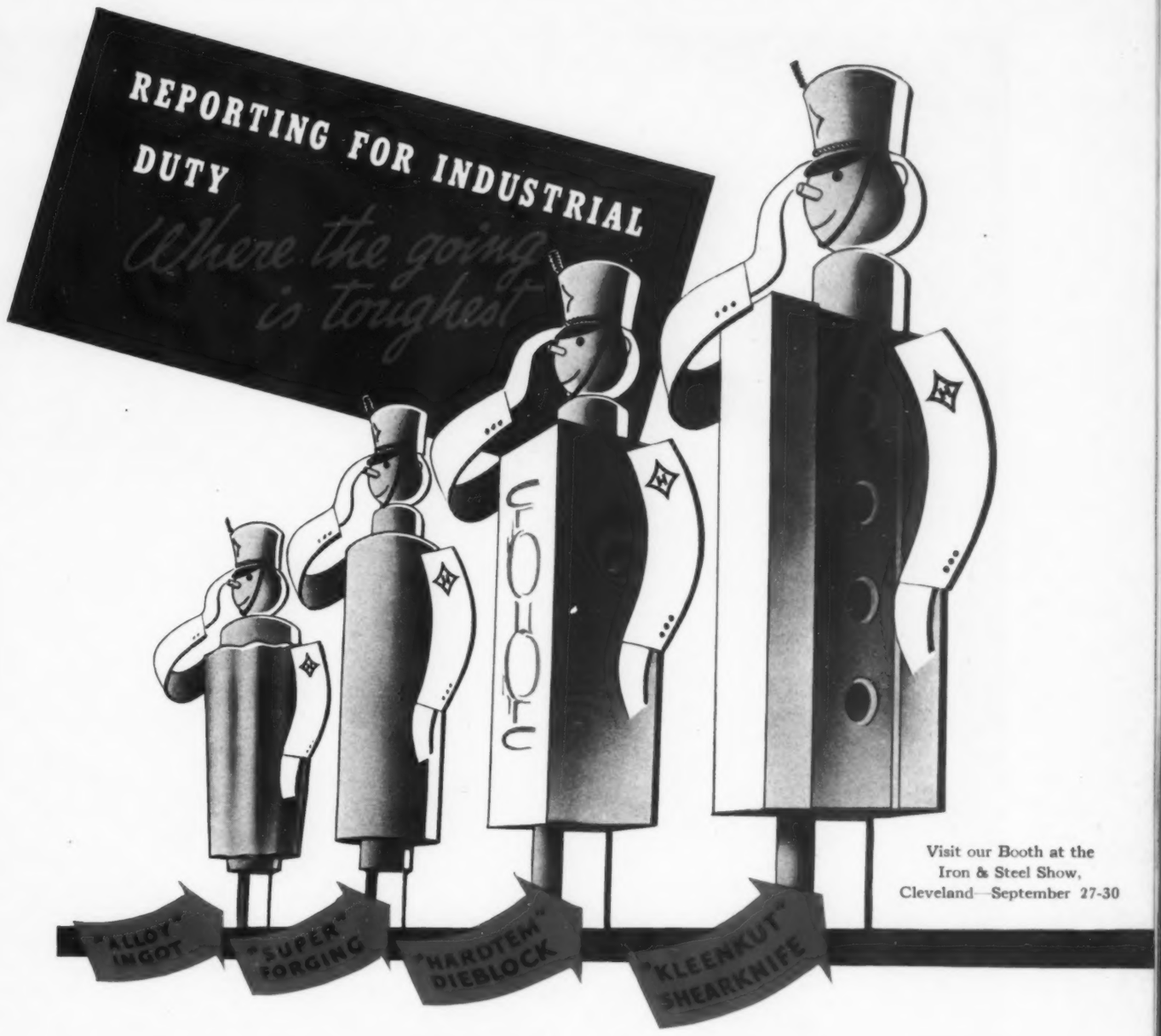
1. **Efficiency of 71.2** lamp lumens directed to the working plane.
2. **Maintenance:** Ventilated construction decreases maintenance cost because smoke and fumes pass out through the ventilators instead of depositing on reflecting surface. Ventilation keeps reflectors bright, assures longer lamp life and decreases lamp and socket failures. Covers not necessary.
3. **Construction: Steel, porcelain enameled;** inner reflector of **Alzak finish aluminum** provides proper light **control** and **distribution.**
4. **Inner reflector** of Alzak finish aluminum is removable without use of tools. Extra inserts, carried in stock by you and quickly substituted, speed up process of cleaning and relamping.

Boiled down, this reflector gives you durability, high efficiency, proper light control and distribution, plus permanent maintenance economy.

As everybody knows, this is only one of many "Ivanhoe" reflectors in a masterful line of high grade engineered lighting equipment for Mazda and Mercury Lamps. Get the complete Ivanhoe Catalog. There's an Ivanhoe distributor near you . . . to give you unexcelled service.

THE MILLER COMPANY • MERIDEN, CONN

Pioneers in Good Lighting since 1844



Visit our Booth at the Iron & Steel Show, Cleveland—September 27-30

Do YOU have a shearing job where short knife-life is boosting costs? . . . Or a drop forging job where dies are wearing out too soon? . . . Or a problem of breakage on shafts, cranks, rolls, or other parts? Just call these Heppenstall shock-troops to lick the difficulty.

Heppenstall products are backed by three generations of active experience. They are produced in a modern plant, geared to produce steel of the highest attainable quality. Practical results show up in use. Heppenstall knives are guaranteed to give superior service. Heppenstall die blocks handle today's tougher metals, give the surface perfection that holds cleaning and grinding to a minimum. Heppenstall forgings have served for years where replaced materials lasted only weeks.

The list below indicates the line of Heppenstall products. Let us work with you in solving your problems.

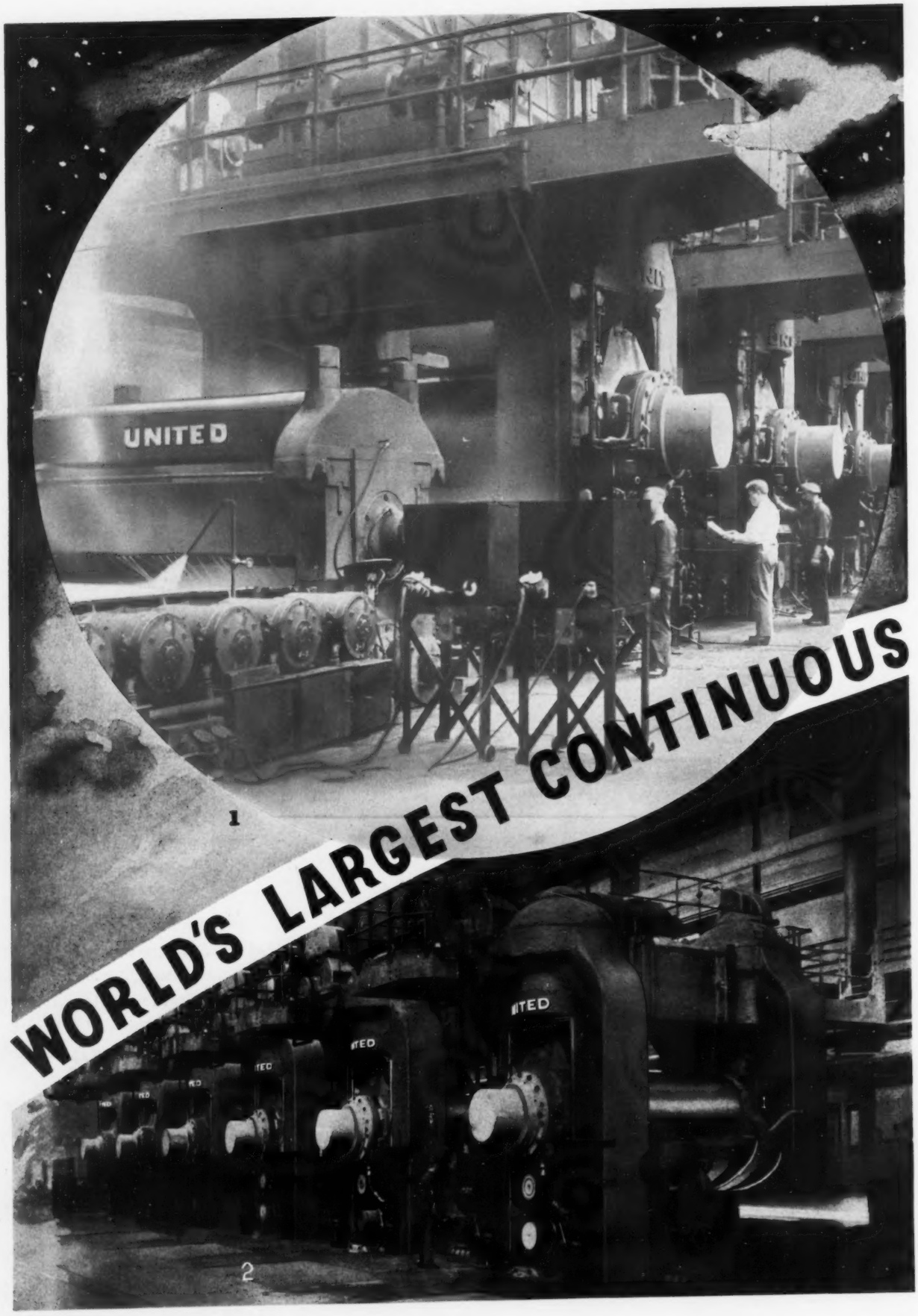
HEPPENSTALL PRODUCTS

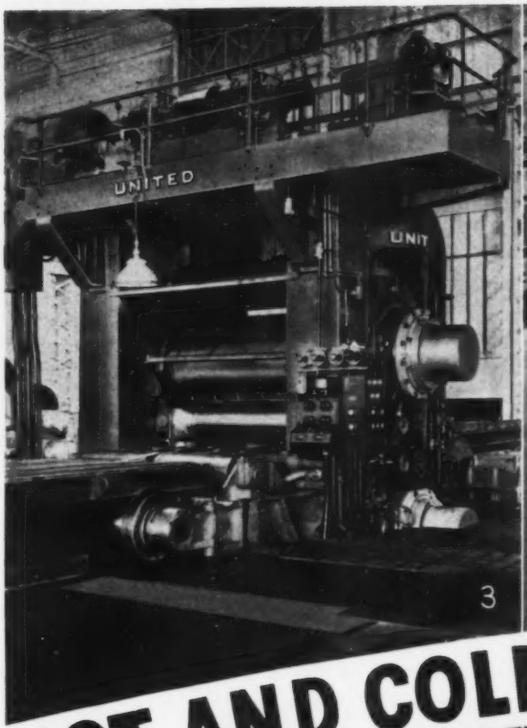
Die Blocks . . . Shear Knives . . . Hammer Rams . . . Piston Rods . . . Tinning and Galvanizing Rolls . . . Gellert Tongs . . . Locomotive Axles, Pins and Rods . . . E. I. S. and O. H. Alloy Steels . . . Carbon and Alloy Forgings.

HEPPENSTALL H Heppenstall has the Experience QUALITY

HEPPENSTALL COMPANY

PITTSBURGH · BRIDGEPORT · DETROIT


UNITED
WORLD'S LARGEST CONTINUOUS
1
2



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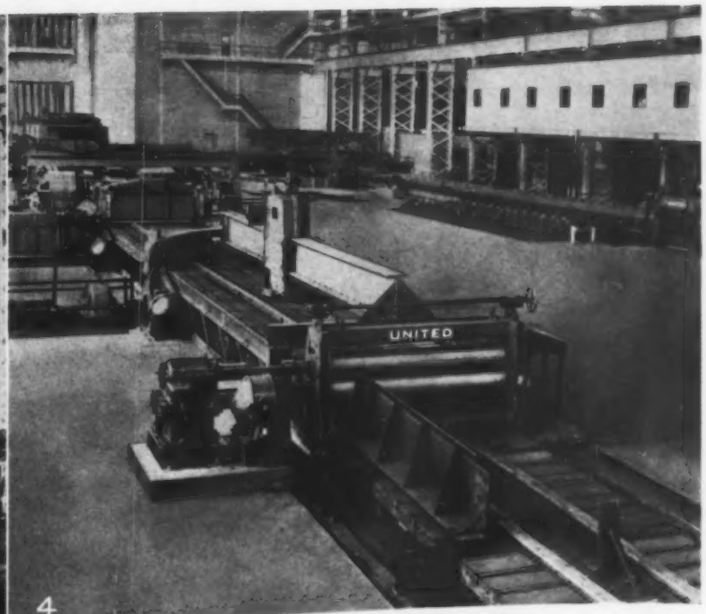
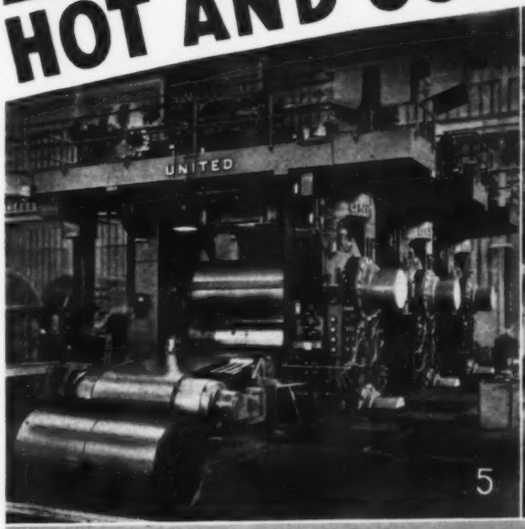


4

HOT AND COLD STRIP MILL ★ ★



5

6

1
98" Continuous Hot Strip Mill—Flying shear at delivery end.

2
98" Continuous Hot Strip Mill—Finishing Stands.

3
98" Single Stand Combination Skin Pass Mill for Strip or Sheets.

4
1/16" Plate Shearing Line Showing Magnetic Depiler, Roller Leveler, Upcut Shear and Gauge, Pinch Rolls and Piler.

5
98" 3-Stand Tandem Cold Reduction Mill with Automatic Uncoiler and Strip Feeder.

6
1/2" Plate Shearing Line and Delivery side of Plate Transfer Bed.

Designed and Built

by UNITED

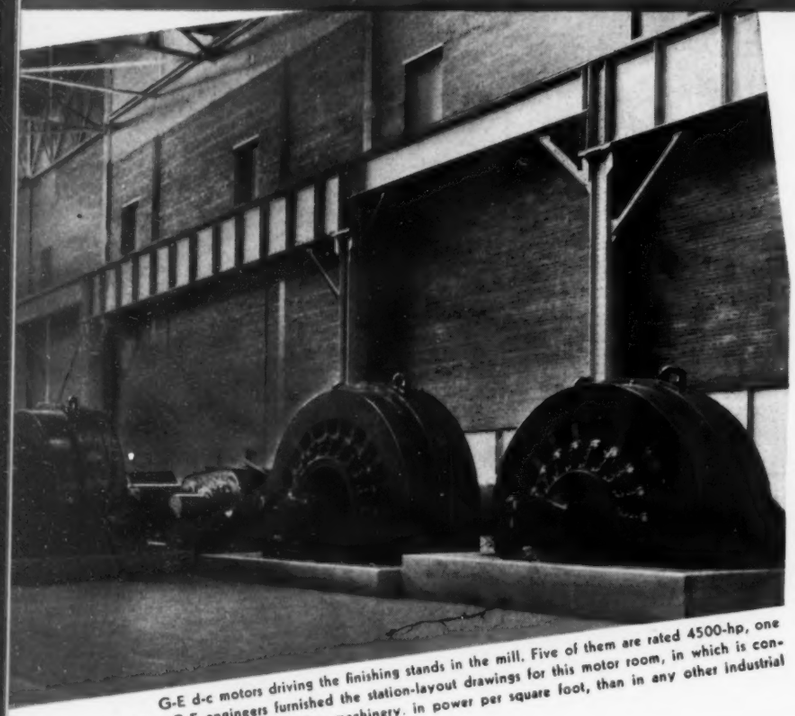
ENGINEERING AND FOUNDRY COMPANY

PITTSBURGH · PENNSYLVANIA

ASSOCIATED COMPANIES:

LOWER COSTS —

Through G-E Equipment IN NEW 98-INCH



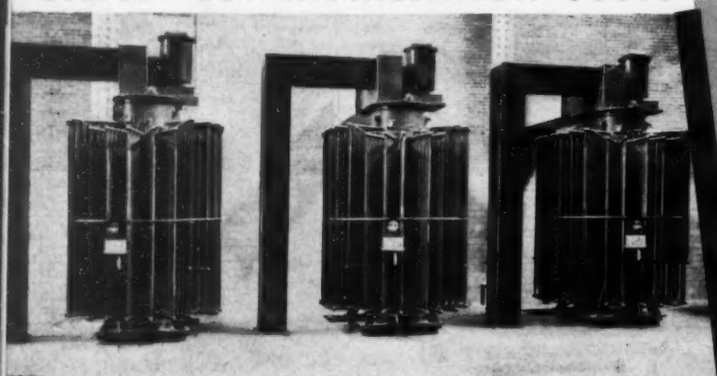
G-E d-c motors driving the finishing stands in the mill. Five of them are rated 4500-hp, one is rated 3500-hp. G-E engineers furnished the station-layout drawings for this motor room, in which is concentrated probably more electric rotating machinery, in power per square foot, than in any other industrial plant.

LOOK at these facts about this new 98-inch continuous-hot-strip mill: A delivery speed of more than 2100 feet per minute, a runout-table speed of 2350 feet per minute, and the rolling of strip as wide as 94 inches. This mill can economically produce not only ordinary steel in large quantities, but also relatively small orders of made-to-order, specially processed steel.

The powerful motors delivering this wide strip at this high speed are General Electric. So are the 300 d-c runout-table motors—a revolutionary application—as well as the control, switchgear, and transformers.

G-E engineers furnished the station-layout drawings for the main motor room, in which is concentrated probably more electric rotating machinery, in power per square foot, than in any other industrial plant.

G-E PYRANOL TRANSFORMERS SAVED SPACE—CUT INSTALLATION COSTS



Three G-E 4000-kva Pyranol filled transformers located in the motor room of the mill. Nonexplosive, noninflammable Pyranol makes unnecessary a special vault for housing the transformers and makes possible their installation near switchgear and motors, thus reducing installation and wiring costs.

THOUSANDS OF DOLLARS IN POWER COSTS SAVED BY G-E ENGINEERING

Under normal operating conditions, widely varying loads are placed on the finishing-stand motors within very short periods — at one moment the stands are empty, but ten seconds later steel may be going through all six stands. The peak load exceeds 30,000 kw.

Such a condition would ordinarily result in wide variation of power-factor and in inadequate voltage regulation, thus adding thousands of dollars to the power bill. G-E engineers, however, worked out and installed a system of automatic synchronous-motor excitation for the motor-generator sets used with the drives. The successful operation of this system keeps power charges at the minimum.

FASTER ROLLING

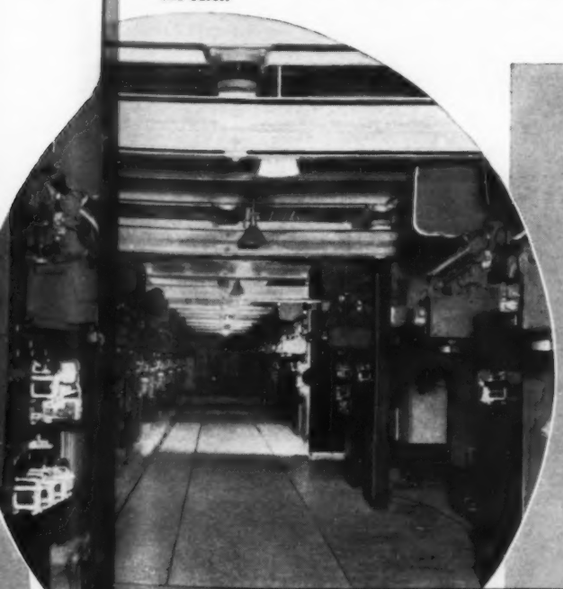
and Engineering—

HOT-STRIP MILL

They worked out the control system that enables the operators to run the entire mill by pushing a few buttons. They solved an involved problem of power-factor control and automatic voltage maintenance. They developed new types of equipment which could be used advantageously to save floor space and to cut installation and power costs.

Some of this equipment and some of these engineering achievements are described on these pages. We believe that they give impressive evidence of the ability of General Electric to deal successfully with the electrical requirements of the steel industry. General Electric Company, Schenectady, N. Y.

View of the six finishing stands, each of which is driven by a G-E motor. Electric motors and control are vital to the operation of this mill. The tremendous speeds and the variety of products would be impossible without them.



G-E 600-volt switchgear for main drives, located in motor-room basement. Equipped with heavy-duty air circuit breakers capable of handling short-circuit current of high magnitude and of protecting machines and buses.

D-C MOTORS FOR THE RUNOUT TABLES AND COILERS— ANOTHER PIONEERING ACHIEVEMENT OF G-E ENGINEERS

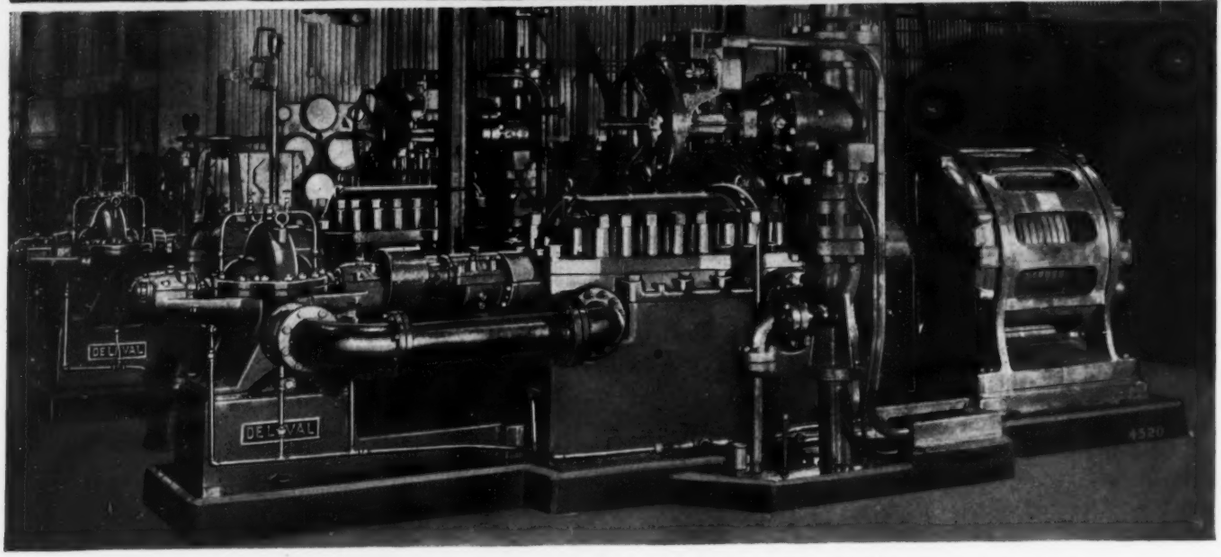
Here are some of the 300 G-E d-c mill-type motors driving the runout tables in the mill—the first application of d-c motors to this type of service. D-c motors, controlled by the G-E system of adjustable-voltage control, have these important advantages:

1. Simpler, smoother, more flexible control, making possible rapid acceleration and stopping.
2. Substantial power savings. The conversion equipment is highly efficient, since several stages of power conversion are eliminated and power losses are cut proportionately.
3. From one-half to two-thirds saving in substation space because of fewer units and simpler control.
4. Lower first cost. Less conversion equipment is required. Furthermore, motors of smaller continuous capacity can be used.

GENERAL ELECTRIC

011-336

DE LAVAL CENTRIFUGAL PUMPS *for Descaling Sprays*



• Installation of two descaling pumping units in a Mid-Western steel mill; 1000 g.p.m. each against 1150 lb. per sq. in. at 1779 r.p.m.

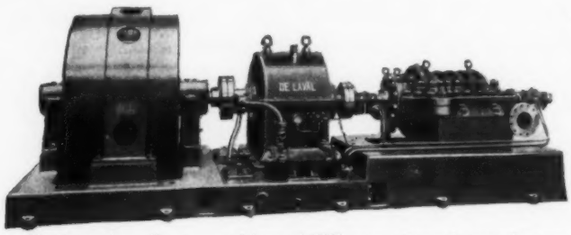
SUDDEN changes of delivery from zero to full capacity as often as 30 times an hour, with the pressure at times jumping to six times normal, are among the conditions successfully met by De Laval centrifugal pumps supplying water at 600 to 1200 lb. per sq. in. for high velocity descaling sprays.

The delivery of De Laval pumps readily adjusts itself to the extreme fluctuations in demand without the aid of governing devices.

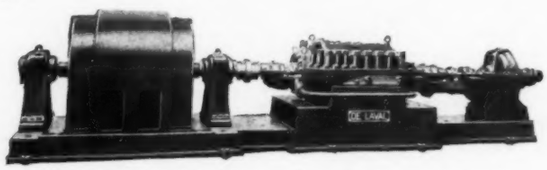
The De Laval automatic hydraulic balancing device makes it impossible for rotating and stationary parts to come into contact and renders a thrust bearing unnecessary. It is unaffected by shocks.

Over-heating by churning during prolonged running at zero delivery is prevented by an automatically controlled by-pass.

3206



• Six-stage descaling pump driven at 2300 r.p.m. through speeding-up gear from 750 r.p.m. motor to deliver 1000 g.p.m. against 600 lb. per sq. in.



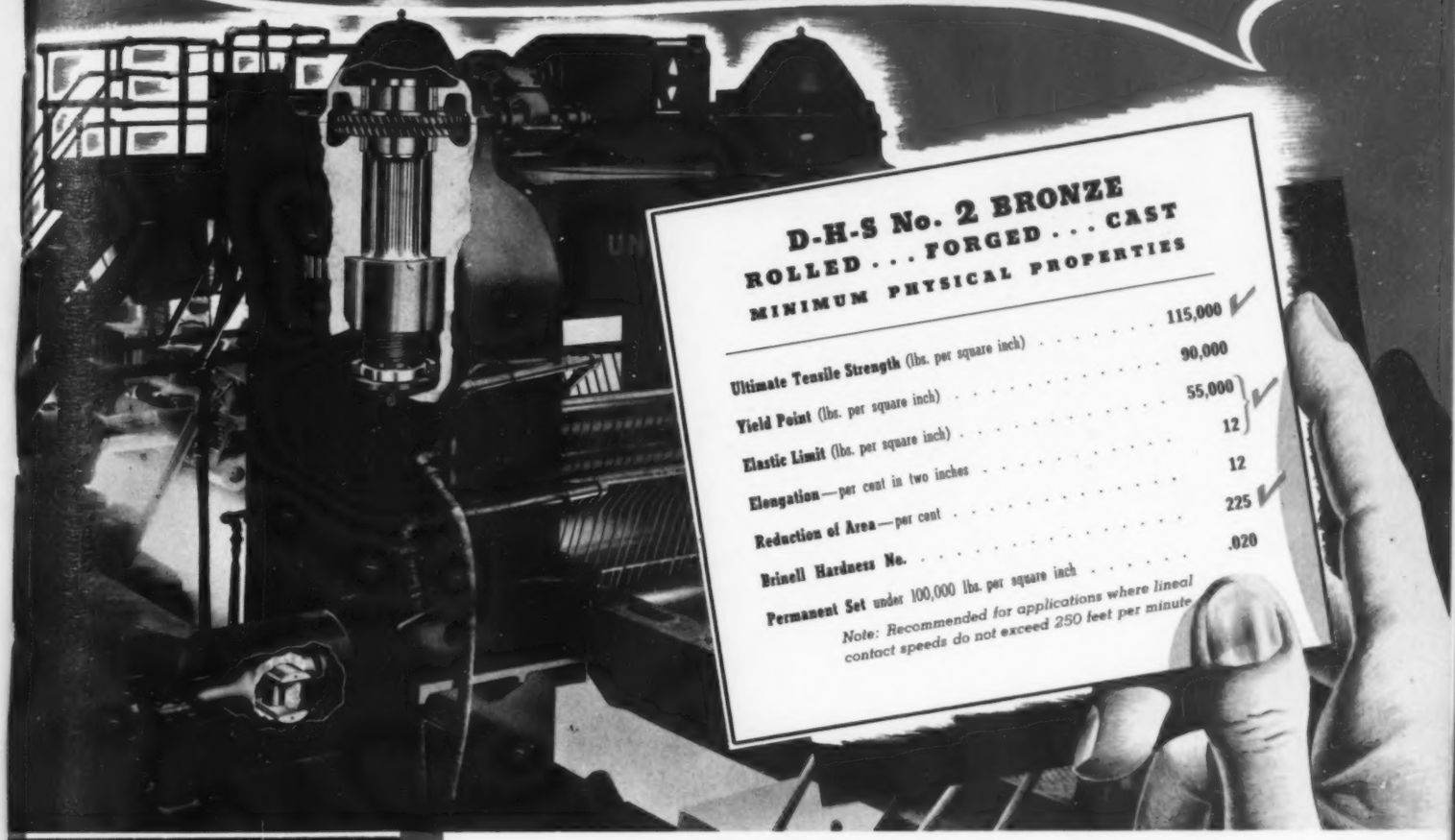
• Pumping unit for descaling spray service; the seven-stage pump delivers 1200 g.p.m. against 2310 ft. head at 1785 r.p.m.; while the booster pump develops 465 ft., the two combined giving a total pressure of 1200 lb. per sq. in.

A letter stating your requirements will bring complete particulars and the recommendations of our engineers.

DE LAVAL *Steam Turbine Co.*
TRENTON, N. J.

MANUFACTURERS OF STEAM TURBINES; PUMPS – CENTRIFUGAL, PROPELLER, ROTARY DISPLACEMENT; CENTRIFUGAL BLOWERS AND COMPRESSORS; WORM GEARS; HELICAL GEARS; HYDRAULIC TURBINES AND FLEXIBLE COUPLINGS • • • SOLE LICENSEE OF THE BAUER-WACH EXHAUST TURBINE SYSTEM

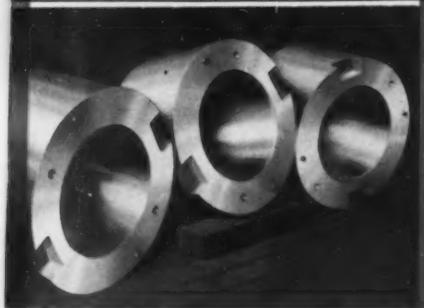
285,000 LBS. OF D-H-S BRONZE IN THE WORLD'S WIDEST STRIP MILL . . .



D-H-S No. 2 BRONZE
ROLLED . . . FORGED . . . CAST
MINIMUM PHYSICAL PROPERTIES

Ultimate Tensile Strength (lbs. per square inch)	115,000 ✓
Yield Point (lbs. per square inch)	90,000
Elastic Limit (lbs. per square inch)	55,000 ✓
Elongation—per cent in two inches	12 ✓
Reduction of Area—per cent	12
Brinell Hardness No.	225 ✓
Permanent Set under 100,000 lbs. per square inch	.020

Note: Recommended for applications where lineal contact speeds do not exceed 250 feet per minute.



Typical D-H-S #2 Bronze Screw Boxes for the Mill illustrated above. Each is 28" in diameter x 19", and weighs 2175 pounds.

Some of the D-H-S #2 Bronze Slippers used in this Strip Mill.

Specified by
UNITED ENGINEERING & FOUNDRY CO.

Where else could you find such a combination of the properties that provide *certainty* of performance?

The superior balance of physical properties, the great strength in compression, and the ability of the material to stand the punishment involved in modern steel mill service, give the assurance of complete dependability that is vital to continuous operation. D-H-S #2 Bronze is serving in steel mills the world over. Especially recommended for Slippers, Segments, Worm Gears, Mixer Nuts, Screw-Down Nuts, Housing Nuts, and Slab Pusher Nuts.

Other Available Alloys

NON-FERROUS ALLOYS
Manganese Bronze
Aluminum Bronze
Nickel Bronze
Silicon Bronze
Phosphor Bronze
Bearing Bronzes
Hydraulic Bronzes
Specification Bronzes
Federal—S.A.E.—A.S.T.M.

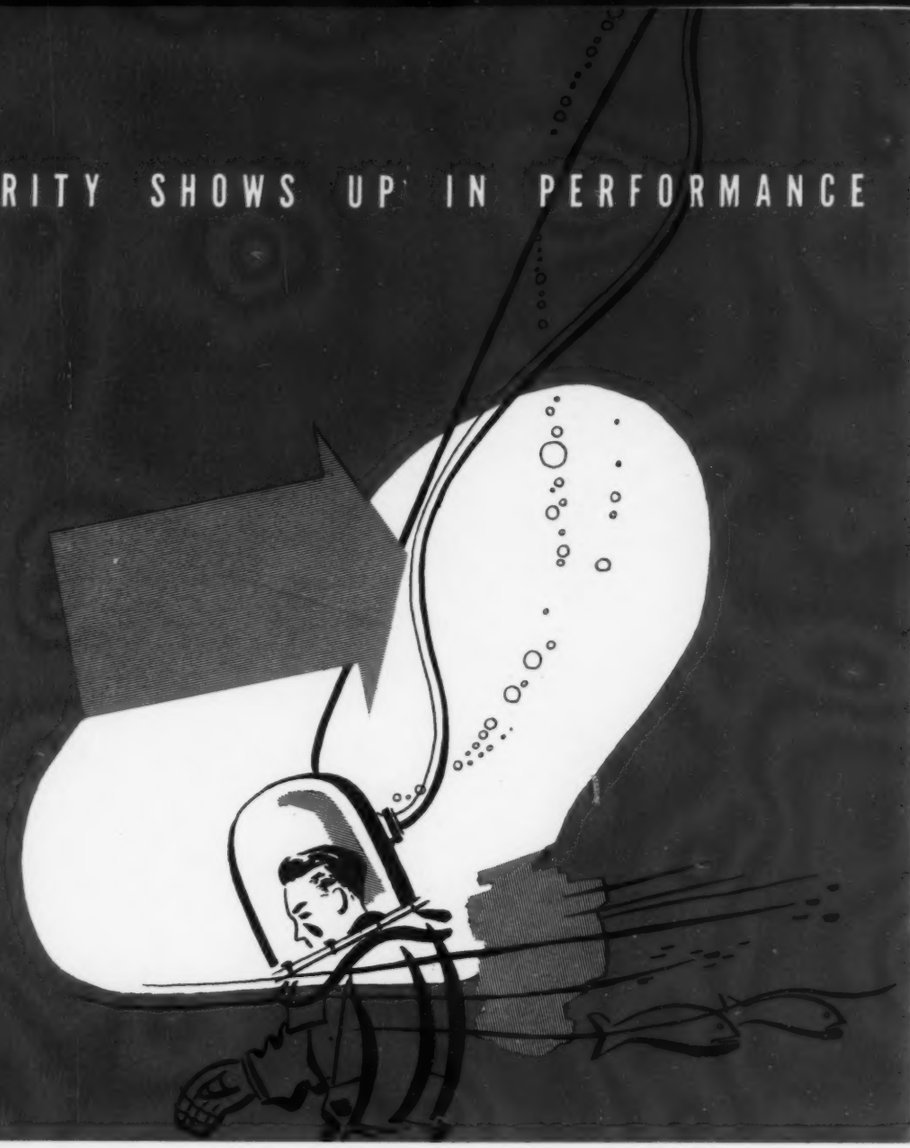
FERROUS ALLOYS
Gray Iron
Semi-Steel
High-Test Iron

KOPPERS COMPANY
BARTLETT HAYWARD DIVISION · BALTIMORE, MD.

D-H-S BRONZE
DUCTILITY · HARDNESS · STRENGTH
LONGER LIFE · LOWER COST

a KOPPERS product

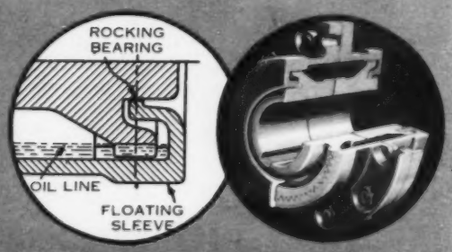
THE SUPERIORITY SHOWS UP IN PERFORMANCE



WHERE YOU CAN'T GAMBLE

The complete dependence of the diver on his equipment has a counterpart in modern plant operation. The shut-down of a single machine may stop production throughout. *Dependability* in the couplings takes on a new significance and explains the ever-increasing demand for Fast's, the original and genuine.

Fast's Couplings represent the unbeatable combination of correct basic design and controlled quality production. From features and refinements exclusive with Fast's come a performance that has won the confidence of countless users. Specify Fast's—there *is* no "equal." Koppers Company, BARTLETT HAYWARD DIVISION, BALTIMORE, MD.



The illustrations show Fast's construction. The load-carrying surfaces are protected from wear by a positive film of oil. This oil is kept permanently clean by the rocking bearings which make precise metal-to-metal contact and are in the one position where they form permanent dust and moisture proof seals. These vital features are found only in genuine Fast's Self-Aligning Couplings.

FAST'S SELF-ALIGNING COUPLINGS

a KOPPERS product

IRON AND STEEL IN CLEVELAND

AIRPHOTO BY AERIAL SURVEYS, INC.

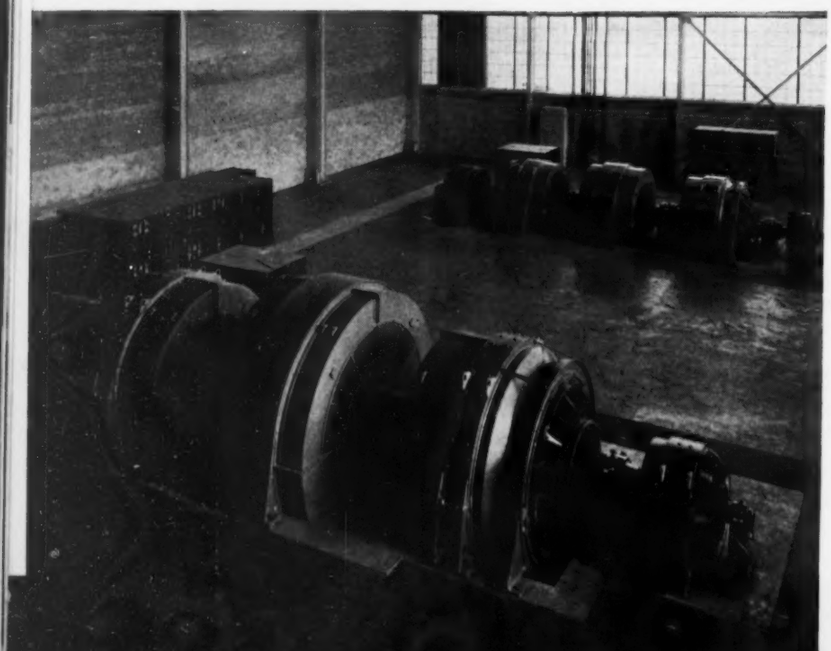
SURROUNDING the blast furnaces and steel mills of Cleveland are hundreds of foundries and factories producing thousands of articles made of iron and steel. There are many advantages in manufacturing in this great international center of the iron and steel trade. Among these advantages is an adequate, dependable supply of electric power at low cost. The wheels of the iron and steel industry, and allied industries, in Cleveland and northeastern Ohio, turn on power supplied by THE CLEVELAND ELECTRIC ILLUMINATING COMPANY.

TODAY'S EQUIPMENT FOR TODAY'S MILL MUST

CUT COSTS... I

INCREASE PRO

KEEP PROFIT MA



THE MAIN ROLL MOTORS of the tandem cold mills are supported by two 5-machine motor-generator sets, rated 6225 kw and 3575 kw

THAT'S WHY EXPERIENCED STEEL MILL MEN SPECIFY ALLIS-CHALMERS EQUIPMENT

Today's equipment for today's mill must be equipment that cuts production costs. It must do its part in producing more goods. It must pay its own way in keeping profit margins steady.

Equipment that generates power for steel mills must produce that power more efficiently than ever before.

Equipment for power transmission must carry power from meter to drive . . . from drive to machine . . . with a minimum of waste.

And equipment that uses power must use it efficiently . . . must pay a dividend in dollars and cents to the mill that buys it.

Today . . . more than ever before in its long history, Allis-Chalmers is building equipment that saves dollars for the buyer . . . that actually pays him a dividend in dollars and cents in increased production . . . in savings in production costs.

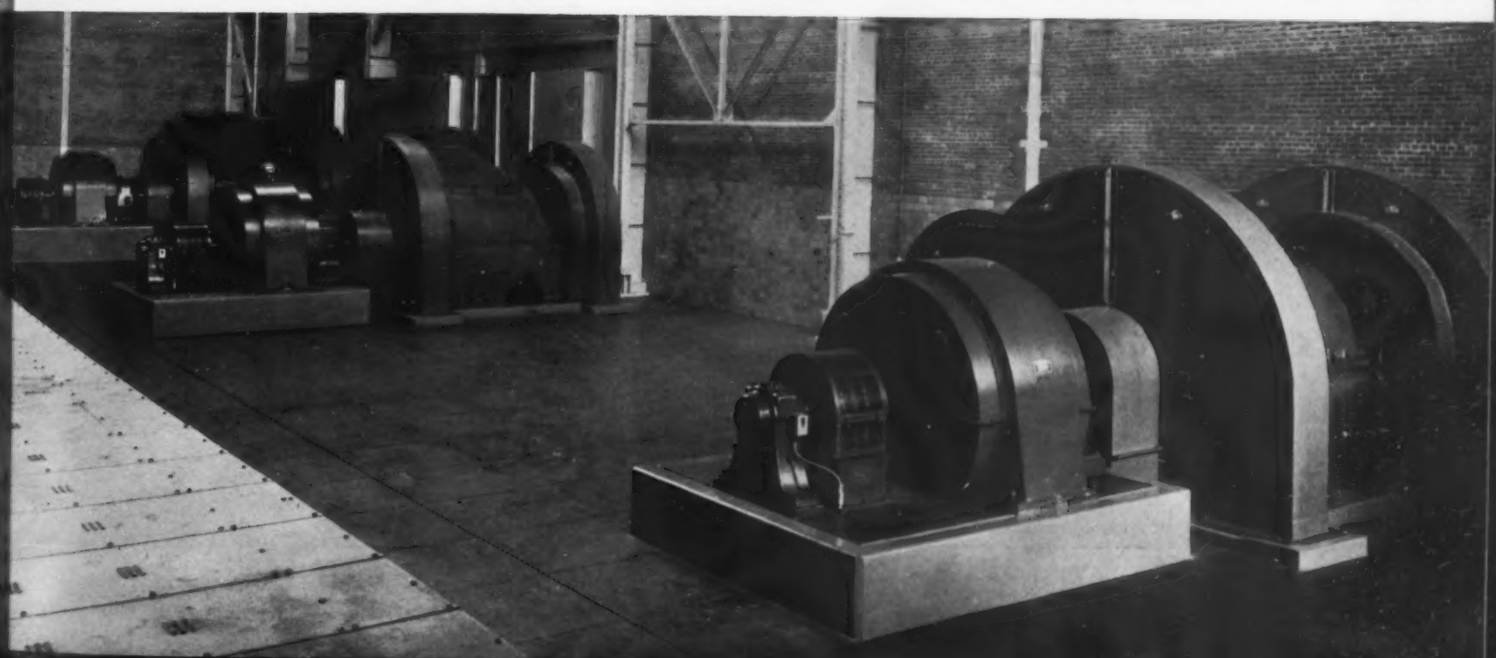
That's why Allis-Chalmers motors and motor-generator sets were chosen for the world's largest 98″ strip mill.

That's why experienced steel mill men throughout the industry specify Allis-Chalmers equipment.

SUPPORTING THE MAIN ROLL DRIVES of the world's largest 98" hot strip mill are these three 6000 kw motor-generator sets, two 600 volt direct-current generators driven by a 7370 kva, 11,000 volt, 3 phase, 60 cycle, 90% P.F. Synchronous motor at 360 rpm

986

ROUCTION...
ARGINS STEADY!

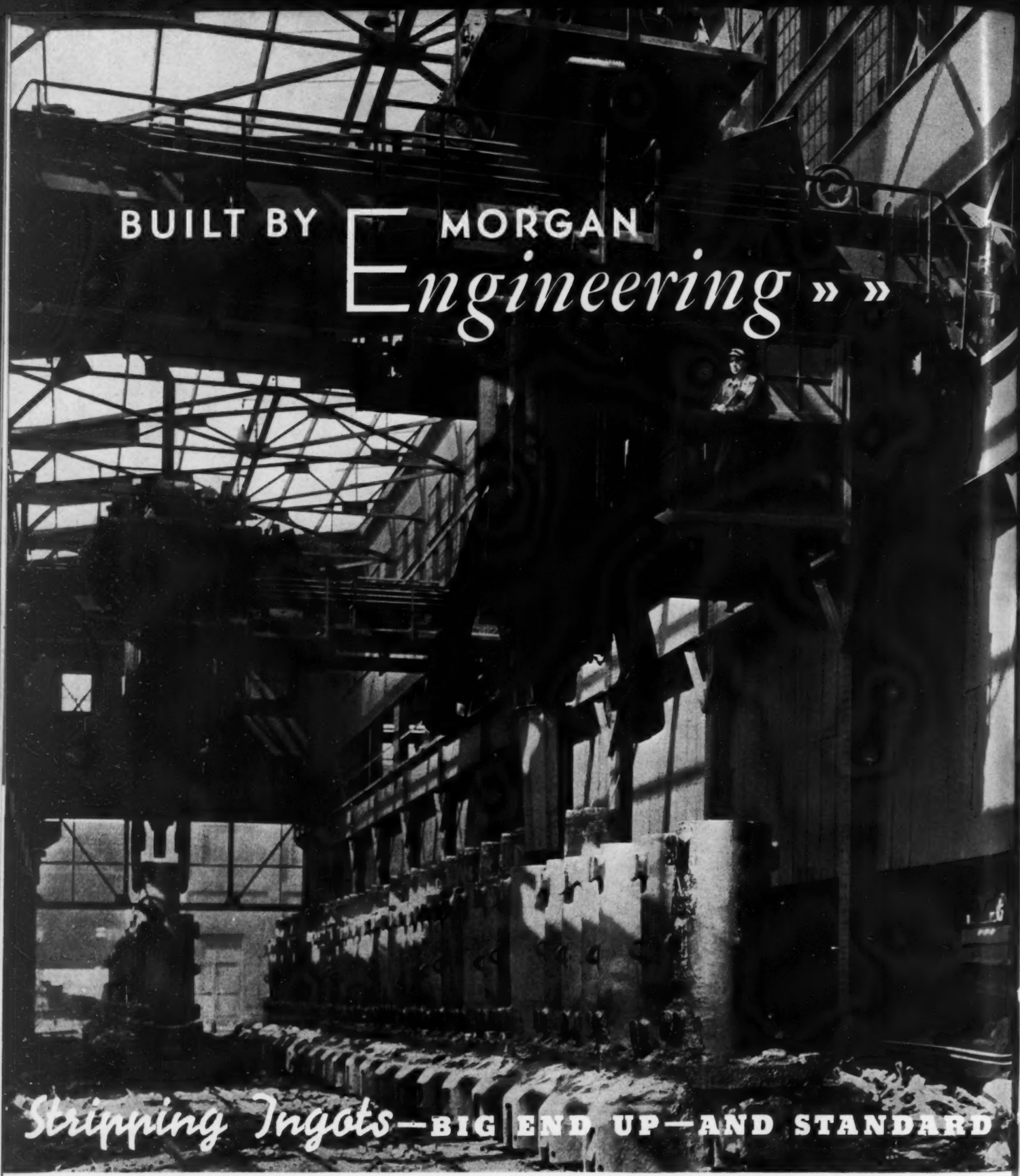


ELECTRICAL DIVISION

ALLIS-CHALMERS

MILWAUKEE·WISCONSIN

DRIVING THE ROUGHING MILL STANDS are these 3000 hp, 2300 volt, 60 cycle, 514 rpm, slip ring motors



Stripping Ingots—BIG END UP—AND STANDARD

● Two of the Morgan 150-ton, 73′6″ span, screw type Ingot Strippers at work stripping standard and big-end-up ingots in a northern Ohio mill. Efficient, rugged, dependable—such huge machines play an important part in stepping up steel production to meet demands of the blooming mills. Morgan Engineering has designed and developed strippers to perform three distinct stripping operations without making changes in the stripping unit. Today this machine is designed to (1) strip small-end-up or standard ingots; (2) strip big-end-up ingots; (3) break small-end-up ingots loose from stools. Faster, more easily controlled than older machines but built to the same high standards of Morgan Engineering integrity.

★

★ **DESIGNERS • MANUFACTURERS • CONTRACTORS**

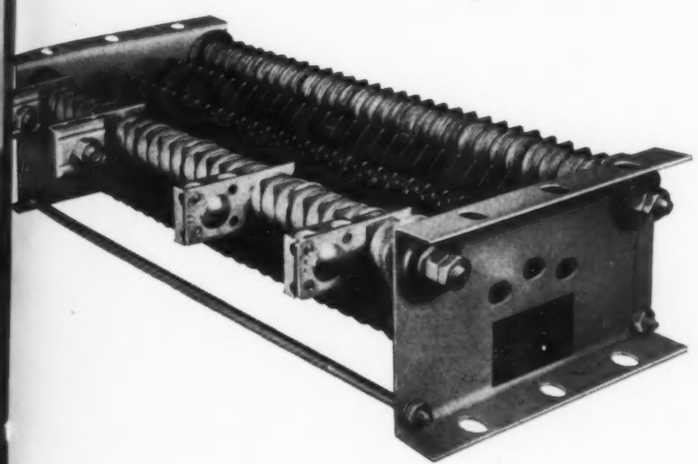
★ BLOOMING MILLS • PLATE MILLS • STRUCTURAL MILLS
ELECTRIC TRAVELING CRANES • CHARGING MACHINES
★ INGOT STRIPPING MACHINES • SOAKING PIT CRANES
ELECTRIC WELDED FABRICATION • LADLE CRANES
★ STEAM HAMMERS • STEAM HYDRAULIC FORGING
PRESSES • SPECIAL MACHINERY FOR STEEL MILLS

★ **THE MORGAN ENGINEERING CO., Alliance, Ohio**
Pittsburgh, 1420 Oliver Bldg. New York, 11 W. 42nd Street

★

Charging Machines carry PASSENGERS...

Month after month, P-G Steel Grid Resistors are being installed on more and more Open Hearth Charging Machines. They defy the two devils of the Maintenance Department—*vibration* and *corrosion*. Many steel plants have standardized on these resistors for all of their applications.



POST-GLOVER RESISTORS are made of cold rolled Alloy Steel and Mica. They are unbreakable in service and are not harmed by moisture or corrosive fumes. Heavy "Steel Mill" construction throughout gives them the ability to withstand overloads and other punishment. To save money and time, and to avoid trouble, specify P-G resistors with new controllers or as replacements.

Visit us at Booth No. 25 at the Iron and Steel Exhibition and let us tell you more about

STEEL GRID RESISTORS

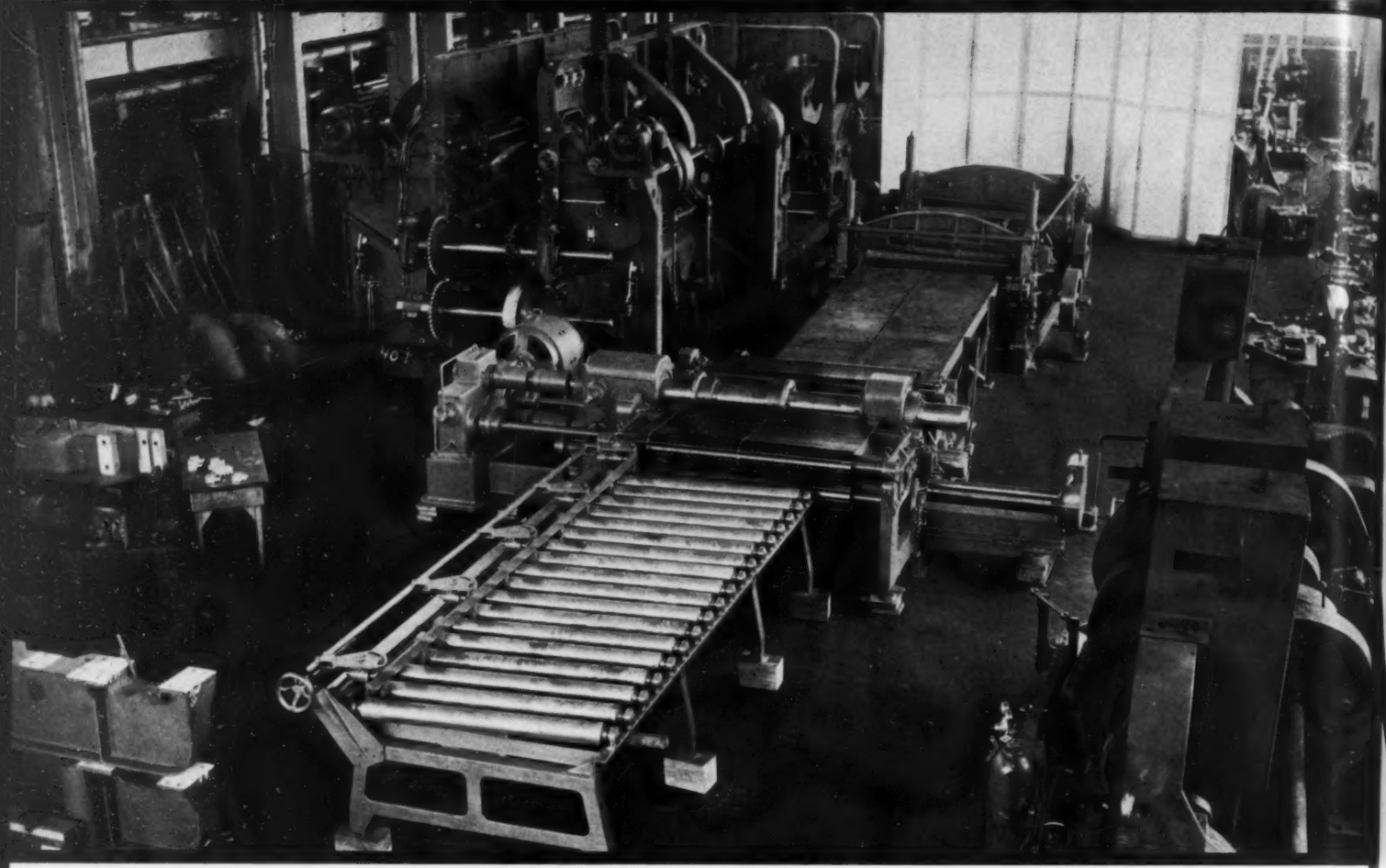
P-G

THE POST-GLOVER ELECTRIC COMPANY

• ESTABLISHED 1892 •

221 WEST THIRD STREET, CINCINNATI, OHIO

The Stamco Line



We specialize in patented Resquaring Units for plates, sheets and tinplate.
GUILLOTINE and ROTARY TYPES

Stamco SHEET and PLATE MACHINERY

Power Squaring Shears - Continuous Mill Shears - Ridge Roll Dies and Presses - Power Gap Shears - Corrugating Rolls - Conductor Pipe Machinery - Gang Slitting Shears.

Corrugating Presses - Roll Roofing Machinery - Sheet Mill Shears - Crimping Rolls - Edgers and Folders - Tin Mill Shears - Roofing Presses - Wahlert Roll Polishers.

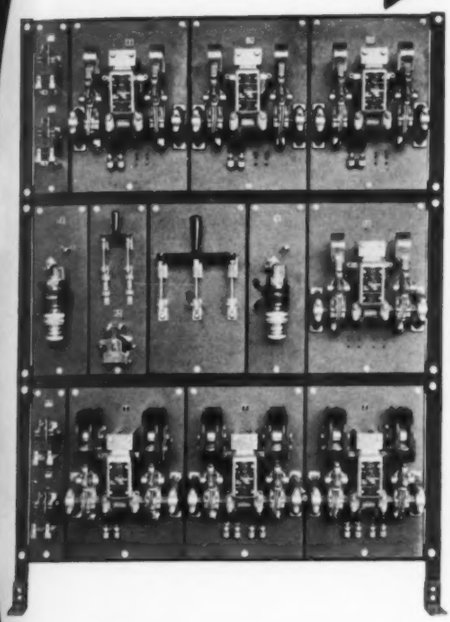
We can furnish shears in welded steel, cast steel or semi-steel construction.
Mechanical holddown, hydraulic holddown, friction clutches, electric back gauges.

THE STREINE TOOL & MFG. CO.
NEW BREMEN, OHIO

FREQUENCY RELAY CONTROL for WOUND-ROTOR A.C.-MOTORS

Demonstrated in operation — applied to

2-NEW DEVELOPMENTS BY EC&M



Reversing Plugging Control Panel with Frequency Relay Control for acceleration and plugging

1-A.C. REVERSING, PLUGGING MAGNETIC CONTROL for CRANE SERVICE

EC&M scores again with two outstanding new developments—one—the control of A.C. wound-rotor motors, entirely by alternating current. Without the aid of conversion units, this new method of control accurately governs both acceleration and plugging conditions in a manner designed to produce the utmost in speed, safety and efficiency.

Unlike time-limit acceleration which closes acceleration contactors at definite intervals, reducing motor torque regardless of load, this new system of acceleration is based on rotor frequency. When the load is heavy, longer time is allowed per step, giving the motor a chance to get under way before the following acceleration contactor closes. Under light loads, however, acceleration time is short, putting the motor across the line in the shortest, safe time. And the plugging contactor is controlled by the same type of relay to operate at exactly zero speed and when so adjusted, this contactor will always close at this point regardless of load.

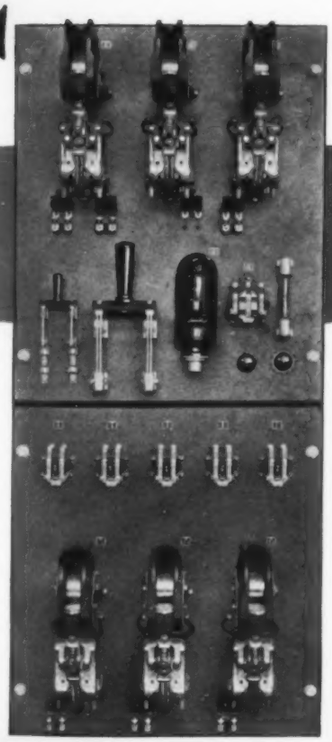
The frequency relays used on this new control are very accurate in their performance. They have silver-to-silver contacts. They are easily adjustable to operate between a wide range of motor speeds for each step.

2-A.C. QUICK-STOP-BY-PLUGGING, NON-REVERSING MAGNETIC CONTROL for Wound Rotor Motors

Using the new frequency relay to open the reverse power contactor at the exact instant that the motor stops. This new starter for wound-rotor motors gives results comparable to a dynamic braking direct current starter.

This control eliminates the need for zero-speed switches or other external mechanically-connected devices.

Make it a point to examine and thoroughly test this new method of control over a wide range of load conditions.



LONG-TIME ACCELERATION for HEAVY INERTIA D.C. LOADS

Over 20 seconds per step if required

For Fans, Saws, Shears with flywheels and similar heavy inertia loads requiring a long time for acceleration, EC&M announces a New LONG-TIME Starter. It is not an adaptation of an existing system of control for d.c. motors, but it is an entirely new development of simple design which gives definite, forced Time-Limit acceleration. The starter exhibited is easily adjustable to provide a wide range of time, from 3 seconds to more than 20 seconds per step. Accelerating periods of several minutes per step are easily obtainable with this new acceleration relay.

THE ELECTRIC CONTROLLER & MFG. CO.
Cleveland, Ohio

Examine ***these outstanding developments at the EC&M BOOTH***

NOS. 84, 85, 86 & 87
CLEVELAND PUBLIC AUDITORIUM
EXHIBITION HALL
SEPT. 27-28-29 & 30

MORE AND MORE HYATTS AS USUAL

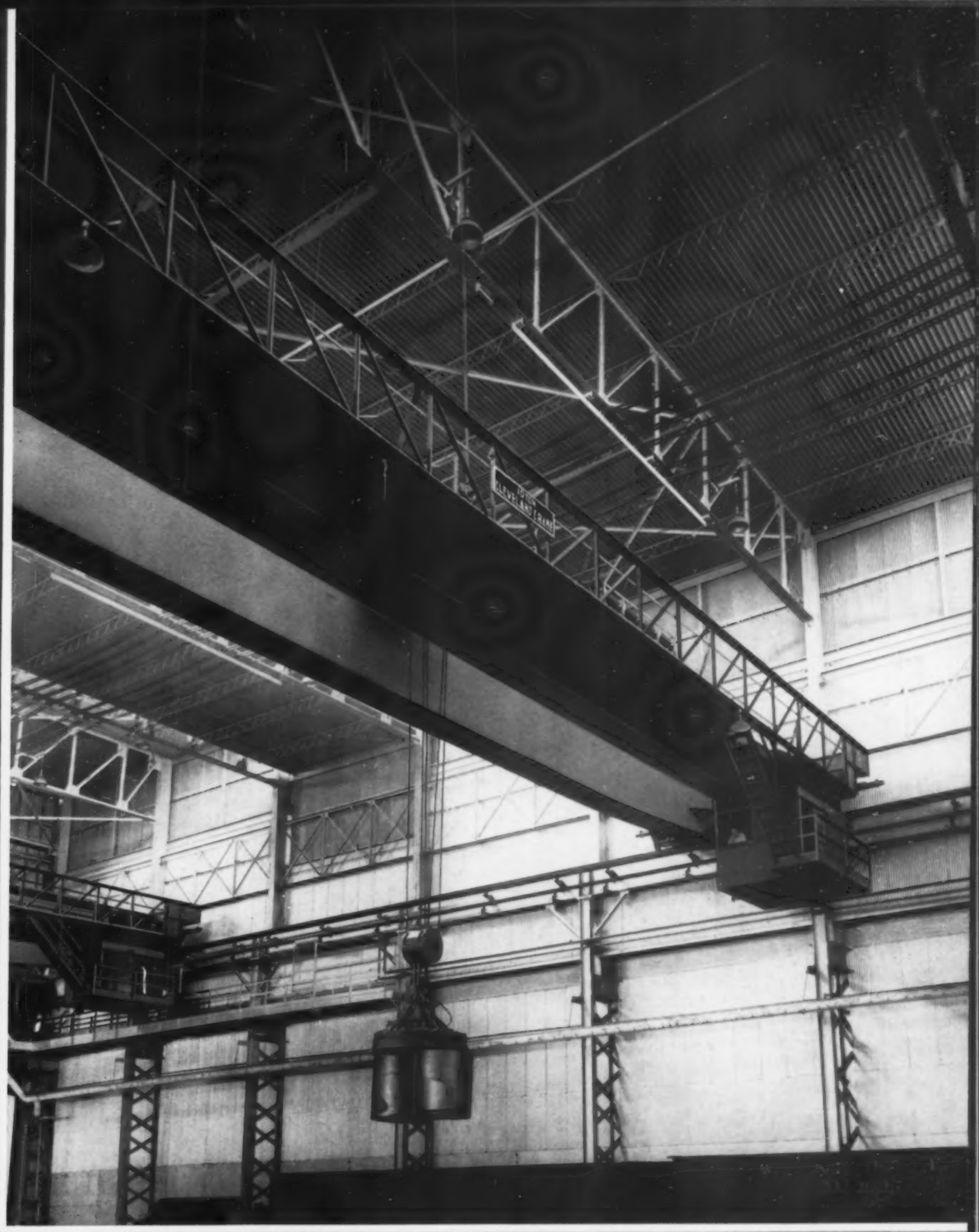
in the NEW 98" Continuous STRIP MILL and 40" BLOOMING MILL

HYATT ROLLER BEARINGS

● Year after year, as you make the A. I. & S. E. Inspection Trip, more and more new equipment is seen operating on sturdy Hyatt Roller Bearings.

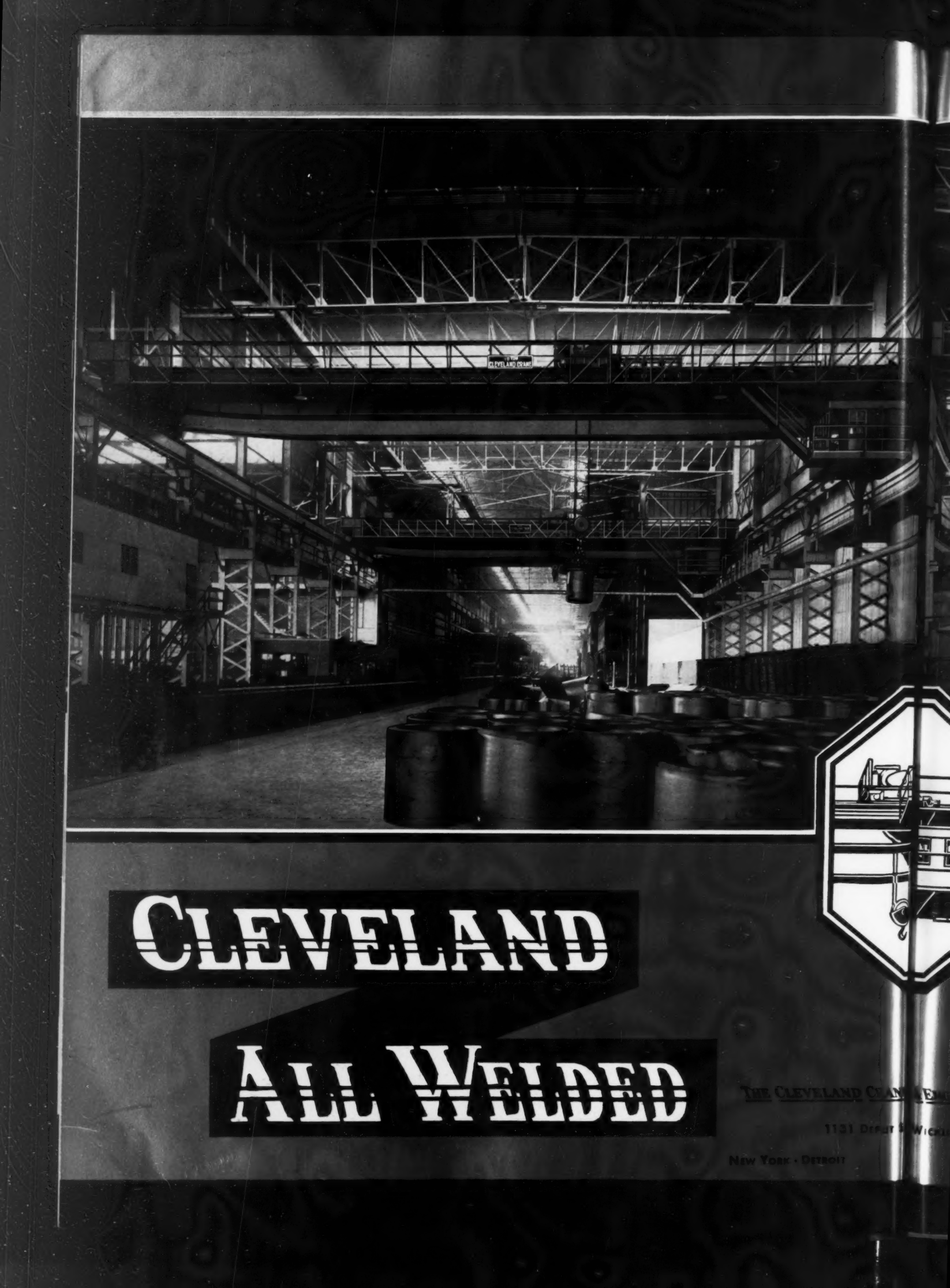
A visible, impressive tribute to their many merits is the fact that whenever changeovers are made to anti-friction bearings or new mills built, Hyatts are always included.

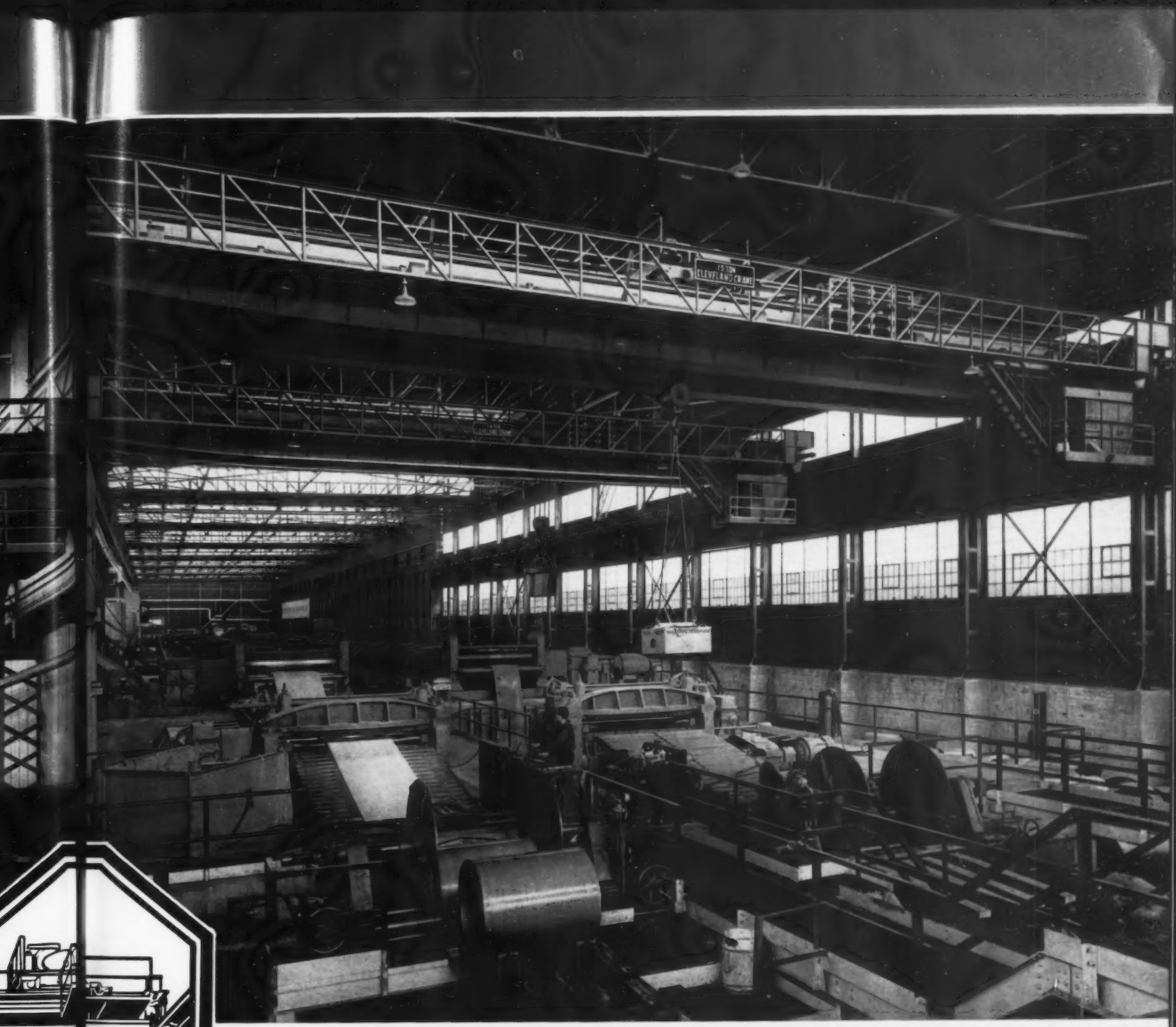
For your tables, cranes, cars and motors, just as we have successfully and progressively served Republic and their equipment builders, we are ready to serve you. Call on us any time, any place. Hyatt Bearings Division, General Motors Corporation, Harrison, New Jersey, and San Francisco. Hyatt Roller Bearing Sales Company, Chicago and Pittsburgh.



CLEVELAND CRANES

ALL WELDED


CLEVELAND
ALL WELDED
THE CLEVELAND CRANE
NEW YORK · DETROIT

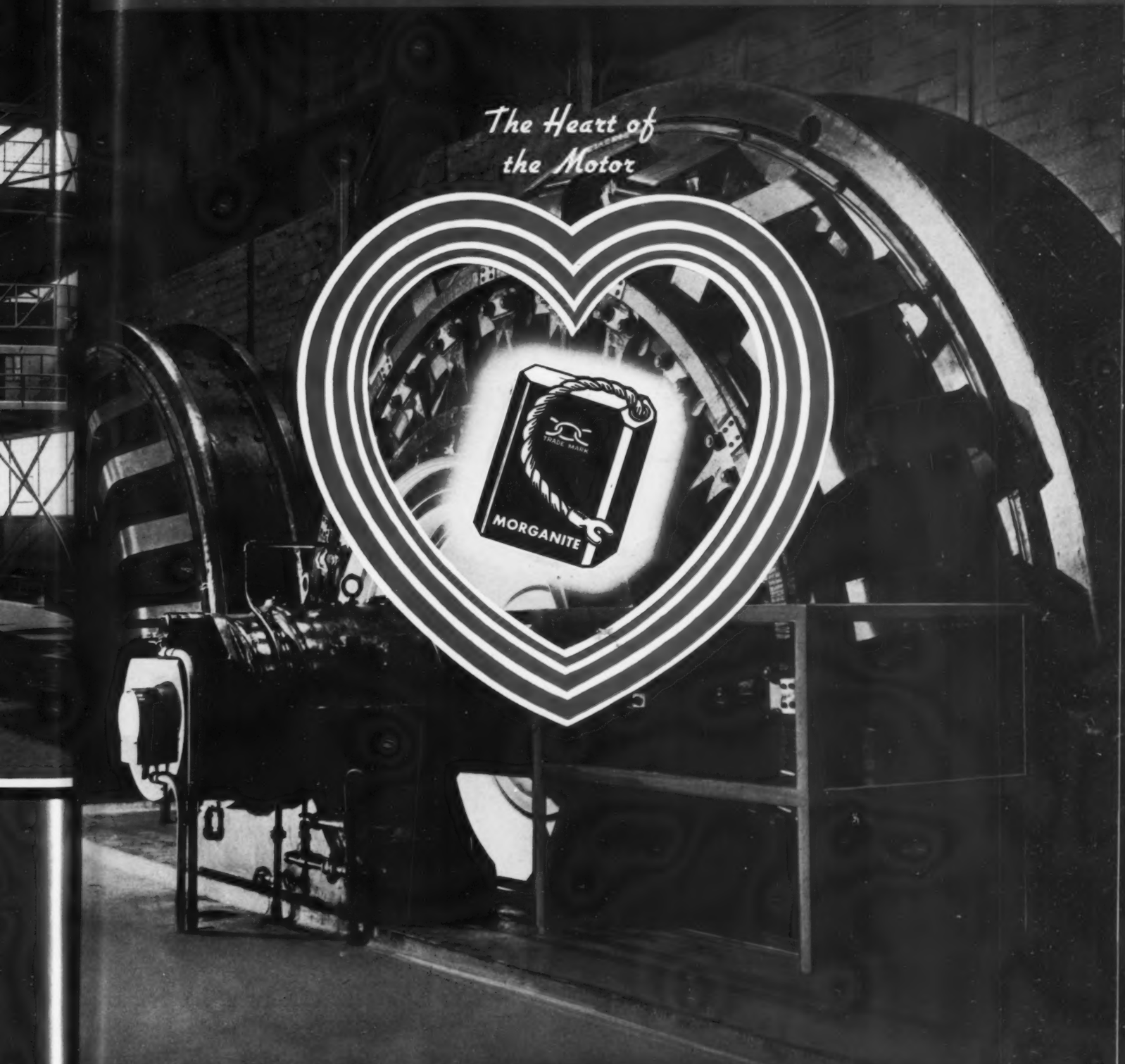


STEEL MILL CRANES

ND CRANE & ENGINEERING CO.
31 DEPOT ST. WICKLIFFE, OHIO
PITTSBURGH · CHICAGO

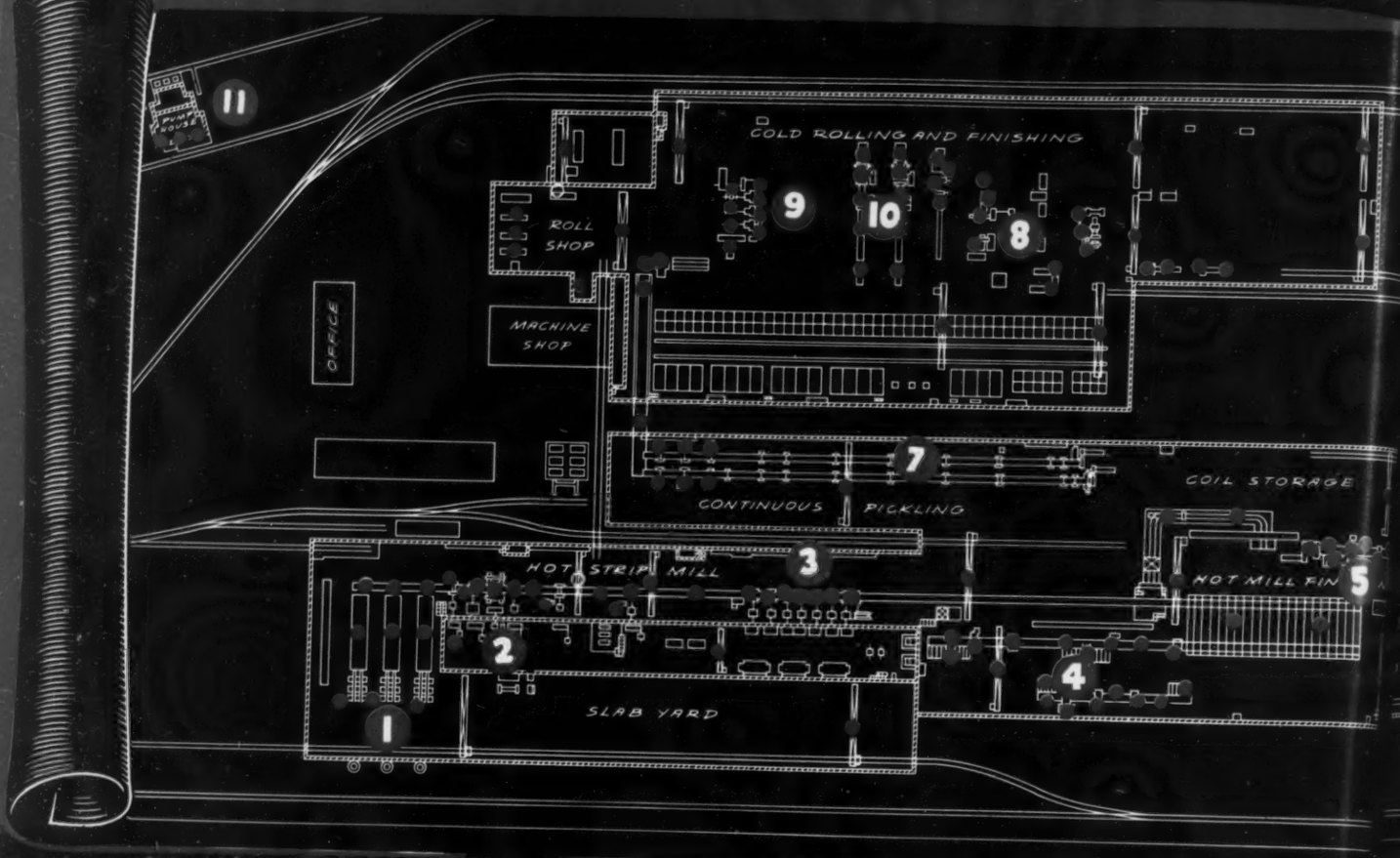
CLEVELAND
ALL WELDED
STEEL MILL
CRANES

THE LIFE OF A STEEL MILL . . .
THE MODERN MOTOR

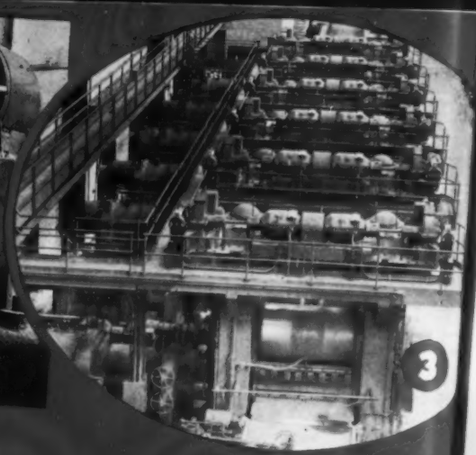


MORGANITE BRUSH CO., INC.

LONG ISLAND CITY — TRADE MARK — NEW YORK



1. Westinghouse MC motors driving slab furnace gushers in hot strip mill.



2. Westinghouse 500 hp. motor driving slab squeezer) and at upper right, one of the three 200 hp. Westinghouse edger motors.

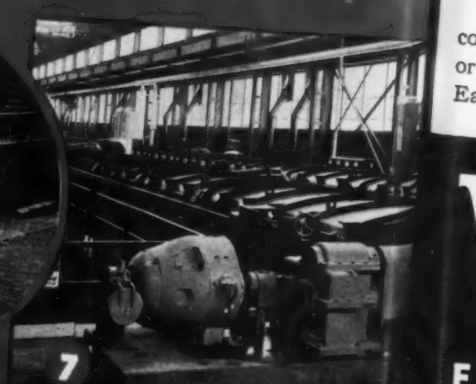
3. Screwdowns on hot and cold strip mills utilize 32 Westinghouse MC motors.

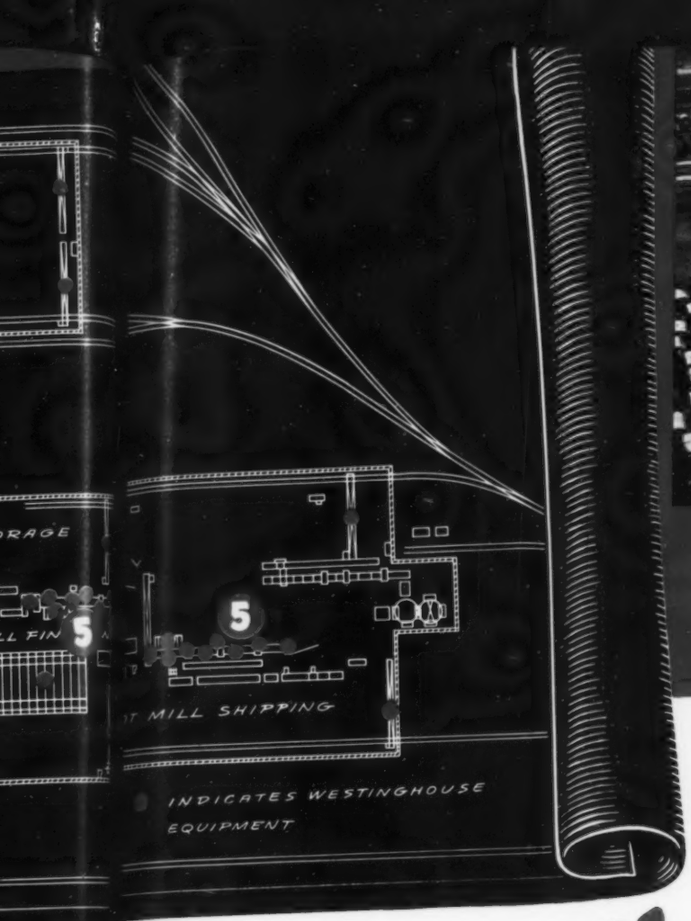
4. Westinghouse equipment in plate finishing department, using SK, MC and CS motors and magnetic control. Foreground — 5/16" shearing line. Background — plate trimming and shearing line and one of 16 balconies housing Westinghouse magnetic control.

5. Foreground — 5/16" trimming and shearing line, with duplicate line in background; and another balcony housing Westinghouse magnetic control.

6. Westinghouse control station, with type SM master switches, typical of those used throughout the plant.

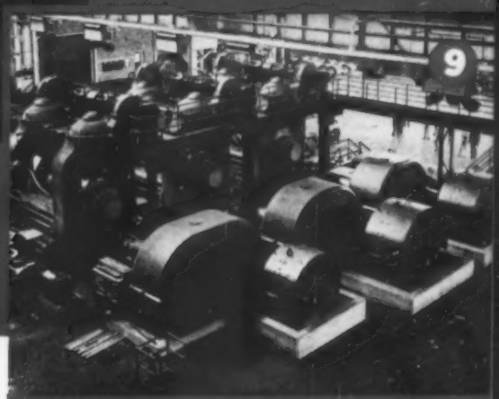
7. Type SK fan-cooled motors driving pinch rolls, re-winding reels, and other machines in continuous strip pickling lines.





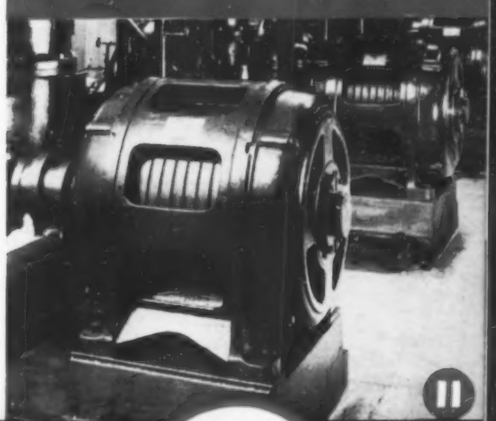
8. Shearing and trimming lines and skin pass mill in foreground, with tandem cold mill in background.

9. Main drives on 98" three-stand tandem cold reduction mill. The seven mill and reel motors driving the tandem and skin pass mills total 9350 hp.



10. Smooth operation at speeds up to 450 feet per minute assured in these two slide trimming and flying shear lines, by variable voltage equipment with individual motor generator sets.

11. 31,200 gallons of water per minute available for pumping through entire plant . . . with Westinghouse motors furnishing the power.



Another "OK" FOR WESTINGHOUSE

World's largest strip mill selects Westinghouse for auxiliary drives

With auxiliaries — the "hidden equipment" — scattered over acres of plant area, far outnumbering main drives, yet vital to production, the necessity for careful selection of apparatus is obvious. Schedules break down, costs skyrocket, if failures of auxiliary equipment occur, or if various parts of shears, trimmers, or other equipment do not perform as a unit.

That's why engineers of this world's largest strip mill gave Westinghouse the "O. K." when they selected auxiliaries. They banked on the years of Westinghouse experience in designing and building electrical apparatus for steel mills. They were buying, not merely electrical equipment, but long-term "insurance" against losses caused by failure of these all-important auxiliaries.

The ability of these Westinghouse "steel-minded" engineers is at your command. Your local Westinghouse office will give you quick service . . . or write to Westinghouse Electric & Manufacturing Company, Dept. 7-N, East Pittsburgh, Pennsylvania.

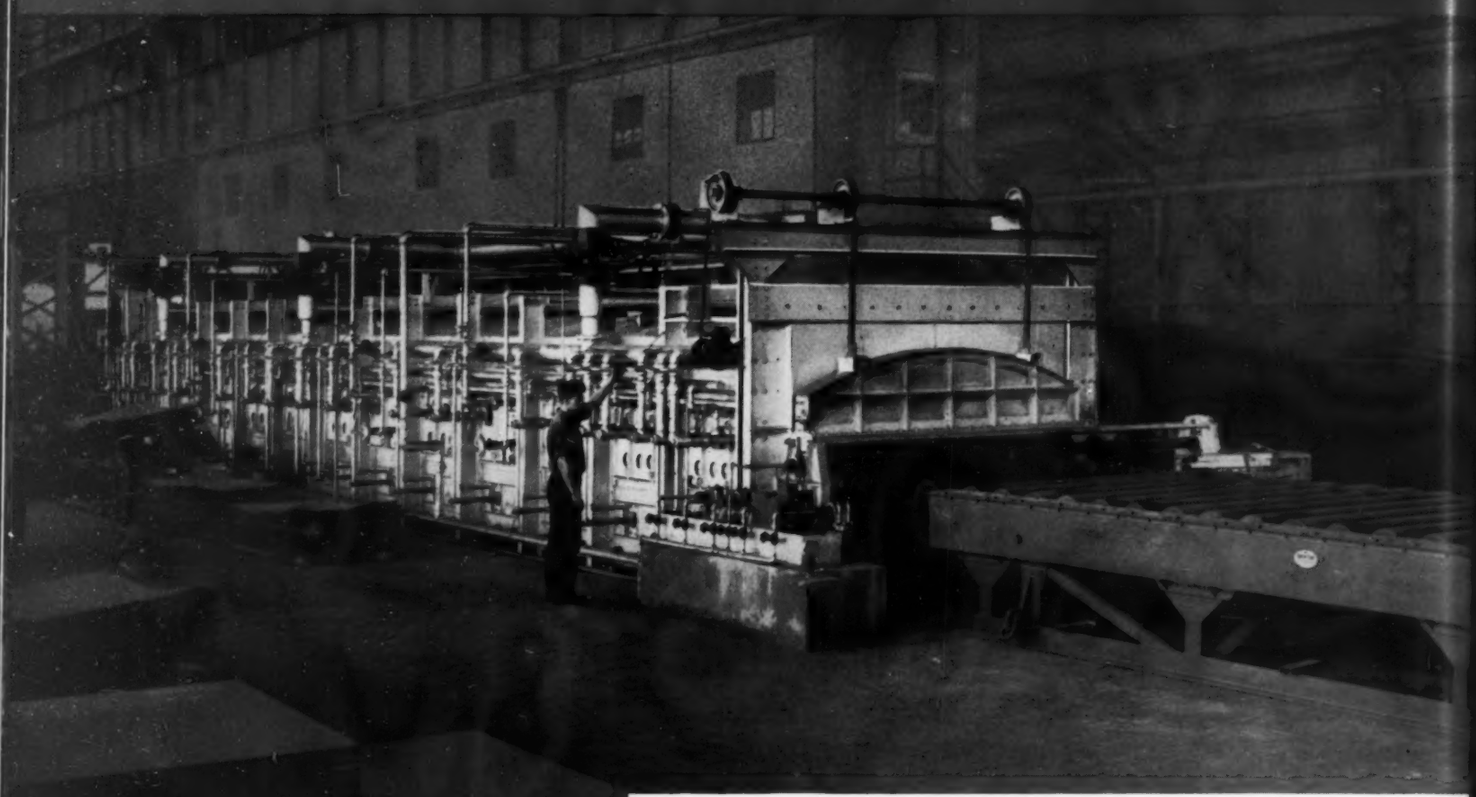
J-93870

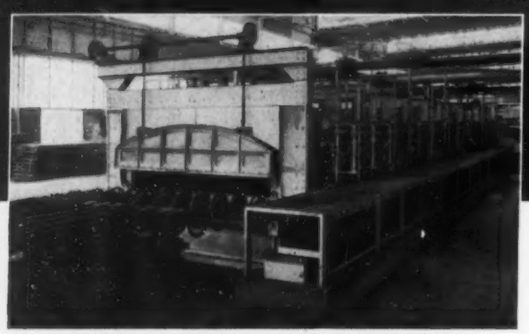
Westinghouse

WESTINGHOUSE ELECTRIC

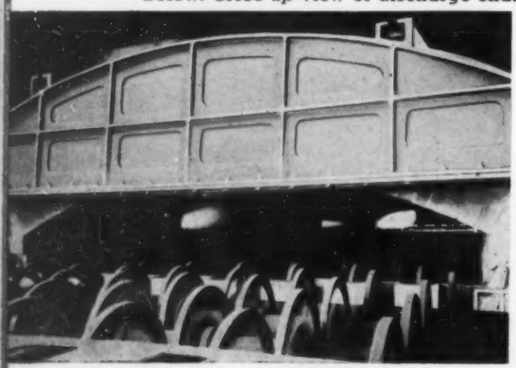
ELECTRICAL PARTNER OF THE STEEL INDUSTRY

IN THE WORLD'S WIDEST STRIP MILL





Above: *Discharge end of furnace.*
Below: *Close-up view of discharge end.*



● Normalizing strip and plate in the world's widest continuous strip mill necessitates a furnace with precise temperature uniformity across its entire hearth. Sheets up to 94 inches wide and ⅜ inch thick are handled in the furnace shown here. Uniform physical properties are obtained regardless of width, length or thickness.

The work is conveyed through the furnace on patented dry alloy disc shafts which are supported inside the furnace on alloy roller bearings. One end of each shaft extends through the furnace side wall and is connected by bevel gears to a line shaft extending the full length of the furnace. Only one drive unit is used which also serves both the charge and discharge tables.

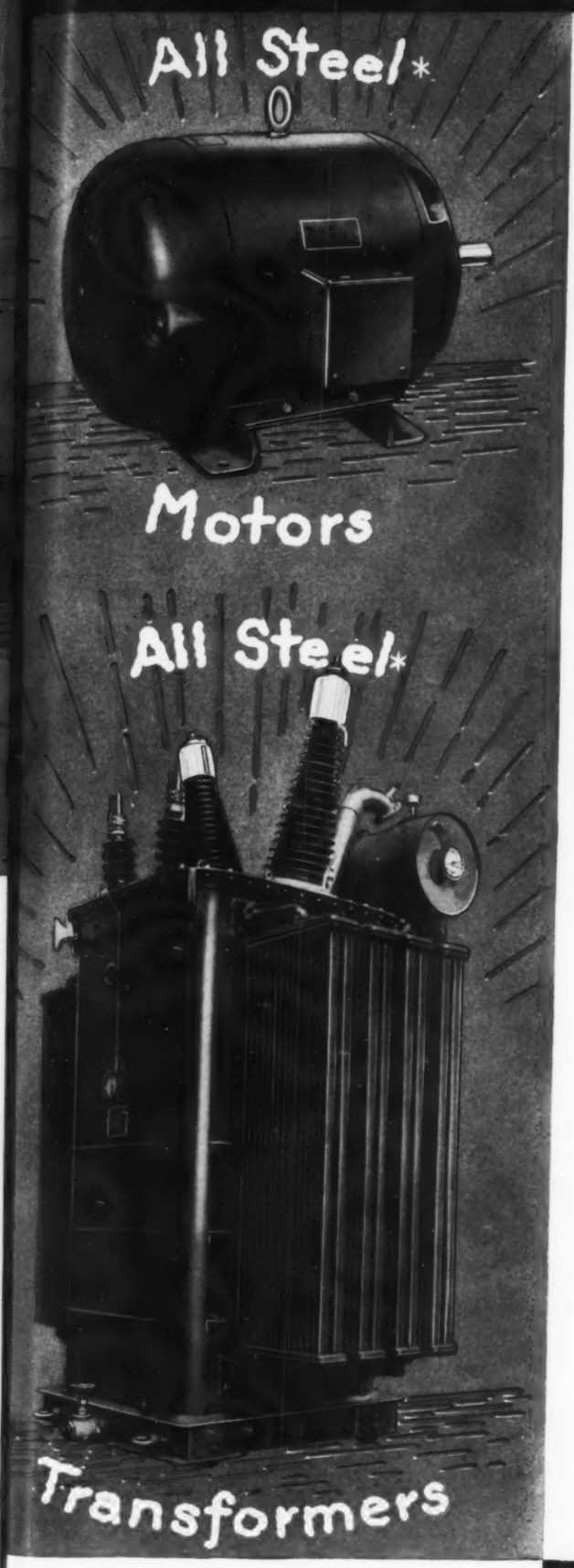
The furnace is divided into three zones, each separately controlled, with natural gas burners firing both above and below the work. This makes it possible to operate the furnace as a blue annealing furnace when desirable. . . If you have an unusual heating or heat treating problem, bring it to SC engineers.

SURFACE COMBUSTION CORPORATION . . . TOLEDO, OHIO

SURFACE COMBUSTION

Builders of ATMOSPHERE FURNACES and HARDENING, DRAWING, NORMALIZING, ANNEALING FURNACES for CONTINUOUS or BATCH OPERATIONS

Modernize with Wagner Motors and Transformers



The mechanical parts of Wagner motors and transformers are constructed almost entirely of steel. Truly, the adjective "All-Steel" is descriptive of Wagner motors and transformers—more than for most other electrical products.

Wagner Motors Use Steel for Strength

In order to insure dependable performance in your plant

Wagner polyphase industrial motors are built to meet the exacting strains of hard, continuous service. They are substantially constructed and will operate smoothly, efficiently and dependably on tough, heavy-duty applications. Ruggedness characterizes every detail of their construction — rolled steel frames, electrically-welded special alloy-steel rotor shafts; low-loss, silicon-steel stator and rotor laminations; full cartridge-type ball bearings or steel-backed babbit-lined sleeve bearings; especially impregnated and fully-taped windings; and dynamically-balanced rotors.

Wagner motors are particularly noted for their good performance and stamina — having proved their ability by operating successfully on hundreds of thousands of industrial applications. Wagner motors are available with the proper characteristics to fit varying service requirements — obtainable in all electrical and mechanical types; in single or multi-speeds; in totally-enclosed or open frames. **Write today for Bulletin 182, which describes all types of Wagner polyphase motors.**

Wagner Transformers Use Steel for Service

In order to insure uninterrupted industrial operations in your plant

Wagner transformers are of sturdy construction and are liberally designed to withstand abuses and to operate at all times at high efficiency. They meet demands for reliable service under all conditions found in industry.

Some of the features of Wagner transformers that mark them as *outstanding* in the utility and steel industries are: strong tanks made of rust-resisting copper-bearing sheet steel; non-aging silicon steel cores; heavy steel endplates; well-insulated windings that are properly protected and braced to withstand surges and strains; high-grade coordinated porcelain bushings; and complete N.E.M.A. accessories and necessary protective devices.

The Wagner line includes every type and size of power and distribution transformers, enabling Wagner to supply all your requirements. Call on Wagner! Forty-seven years' experience in the electrical field is at your disposal. If you desire more information about Wagner transformers and their application in the steel industry, **write the nearest Wagner branch. Descriptive literature will be sent upon request.**

EE238-1F

Wagner Electric Corporation

6400 Plymouth Avenue, Saint Louis, U.S.A.

MOTORS TRANSFORMERS FANS BRAKES

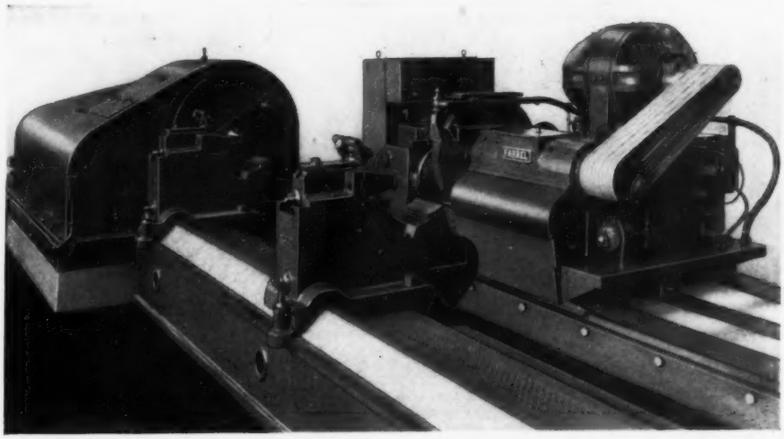
FARREL EQUIPMENT *for the* STEEL MILL

REG U.S. PAT. OFF.

FOR LOW-COST PRECISION ROLL GRINDING

Farrel Heavy Duty Roll Grinders rough and finish rolls of any material; grind a perfect surface free from marks of any kind, with straight, concave or convex contours of exact symmetry and accuracy. They reduce the time required for finishing, increase the output of finished rolls and lengthen the life of the rolls themselves.

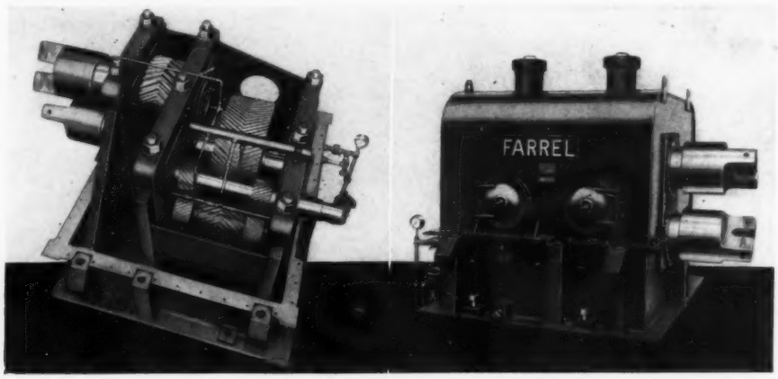
Visit our booth, No. 127, at the Iron and Steel Exposition in Cleveland and learn about the advanced features of design which are responsible for the smooth, vibrationless performance, superior finish and high output of Farrel Heavy Duty Roll Grinders.



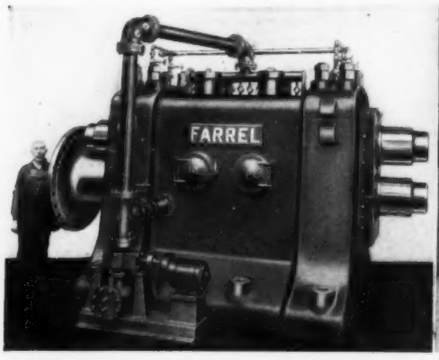
Farrel Heavy Duty Roll Grinders are built in six standard sizes to grind rolls up to maximum diameters of 24", 28", 36", 44", 50" and 60", and lengths from 8' 0" to 26' 0" between centers. The machine illustrated above is 60" x 22' 0".

SMOOTH, QUIET RUGGED GEAR DRIVES

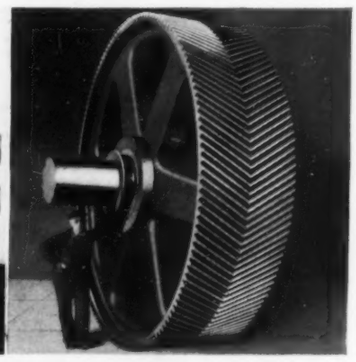
Farrel Heavy Duty Rolling Mill Reduction Units and Pinion Stands are of rugged construction to withstand the stresses, shocks and wear incident to high speeds and heavy loads encountered in modern mill practice, yet they are made with a high degree of precision to provide the quietness and smoothness of operation which is as essential in large mill drives as in smaller machines. Modern design, modern materials and modern methods of construction are properly combined and applied by engineers and mechanics who have a thorough knowledge of the problems involved.



Two views of a Double Reduction Unit with integral 20" Pinion Stand for driving 20½" and 53" x 48" four-high temper pass mill. Drive has welded steel case, single and double helical reduction gears, double helical mill pinions, anti-friction roller bearings.



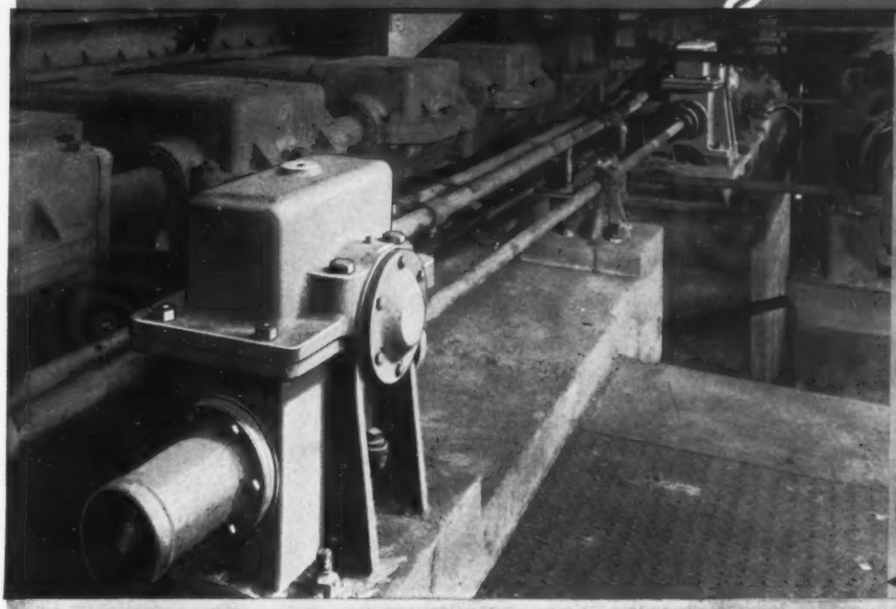
4,000 H.P. Pinion Stand for 20" and 52½" x 72" four-high reversing cold strip finishing mill. Housing of steel castings and rolled plate welded together.



Farrel-Sykes continuous tooth herringbone gear for rolling mill drive, 5,000 H.P., weight 51,700 lbs., 145" diameter, 145 teeth, 1 D.P., 40" face.

FARREL-BIRMINGHAM COMPANY, INC.
ANSONIA, CONN. - BUFFALO, N. Y.
Branch Offices: New York, Pittsburgh, Akron, Chicago, Los Angeles

In the World's *Largest* Strip Mill, designed to Produce at *Lowest* Cost–



"United" Traverse Drive-Reel Unloader
"United" Tilting Device—Reel Unloader
"Mathews" Roller Table Drive
←"United" Cold Runout Table Drives

Cleveland Worm Gear Speed Reducers contribute an important part to manufacturing efficiency in this great new plant

"United" Pullback Drive

• Size alone is secondary to efficiency and both, in turn, must be supported by the rugged, dependable performance of all equipment, to insure continuous production.

The Steel Industry—doubtless the most merciless of all proving grounds for worm gear speed reducers—gives Cleveland a large share of its annual volume. From one application in 1917, Clevelands are now serving *more than 225 separate uses in steel alone.*

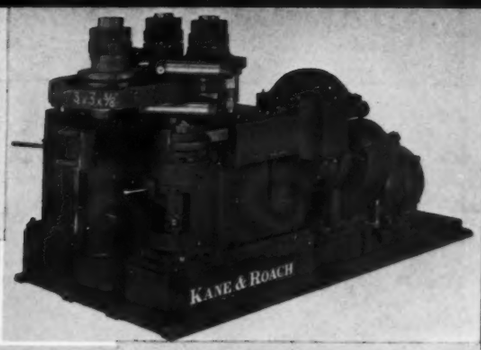
On the basis of delivered horsepower and comparable design, you pay no more for Cleveland Worm Gear Drives—their extra stamina and endurance are your *extra* profit through long, unbroken years of service. The Cleveland Worm & Gear Company, 3278 East 80th Street, Cleveland, Ohio.

Affiliate: The Farval Corporation, Cleveland, Manufacturers of Centralized Systems of Lubrication

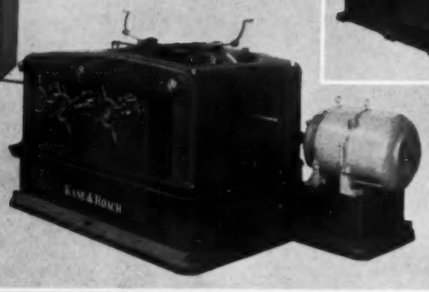
★ CLEVELAND *Worm Gear Drives*

MAKING THE MACHINE FIT THE JOB

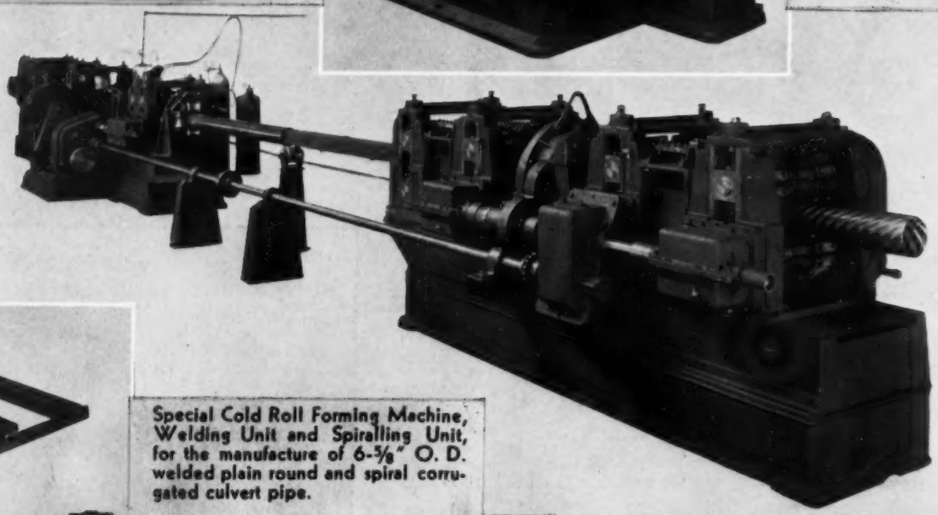
FIFTY ONE YEARS OF EXPERIENCE
1887-1938
STRAIGHTENING ROLLS
BENDING ROLLS
COLD ROLL FORMING MACHINERY
GANG SLITTERS

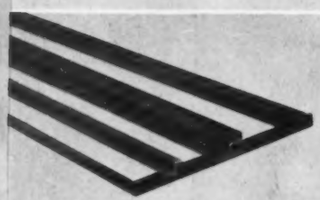


No. 5150-B 5-roll Rotary Straightener.



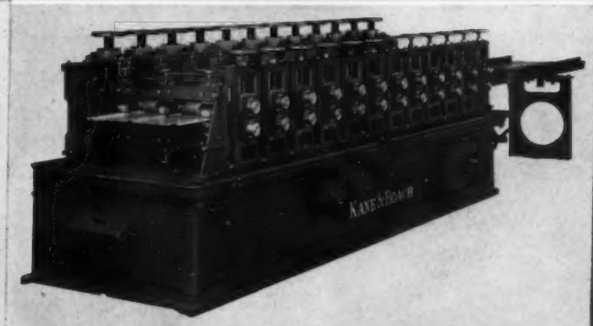
No. 22 Horizontal Angle Bending Roll.





Special Cold Roll Forming Machine, Welding Unit and Spiralling Unit, for the manufacture of 6-⅝" O. D. welded plain round and spiral corrugated culvert pipe.

No 1A Combination Vertical & Horizontal Straightening Roll, equipped with No. 1A Mill.



No. 1L 12-225 Cold Roll Forming Machine, Outboard Housing Type, Series L, rolling roofing deck.

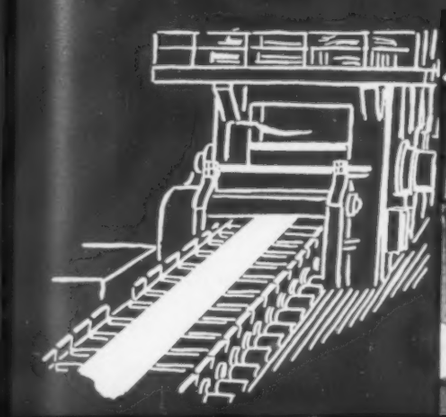
MORE THAN **30** KANE & ROACH MACHINES IN SERVICE, FORMING, STRAIGHTENING, AND BENDING, IN ONE OF THE LARGEST STEEL COMPANIES IN THE OHIO TERRITORY

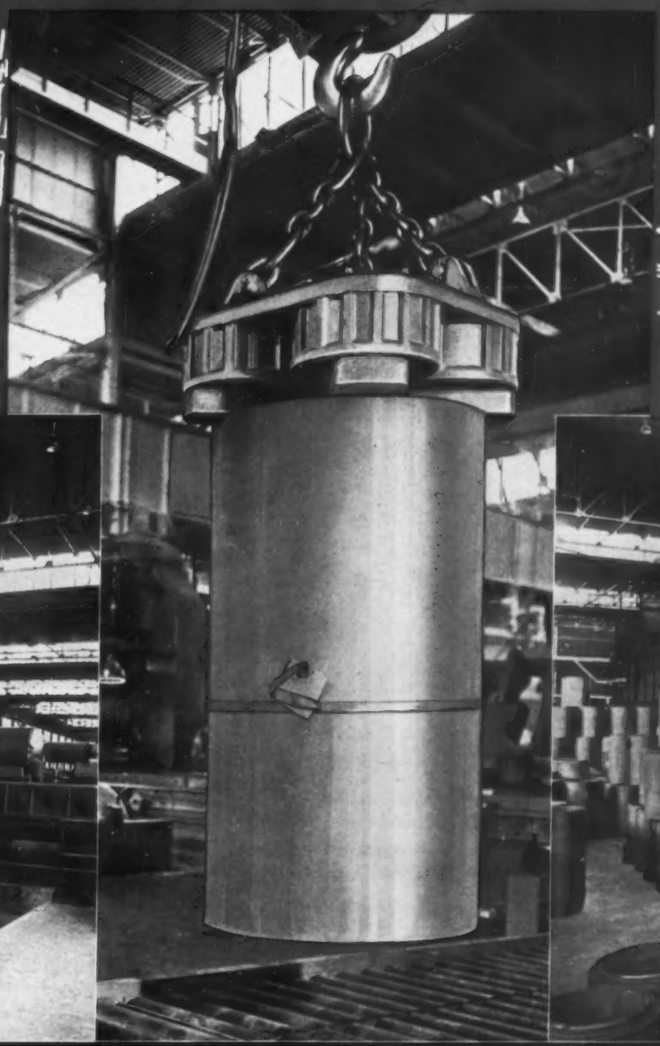
K & R
ESTABLISHED 1887

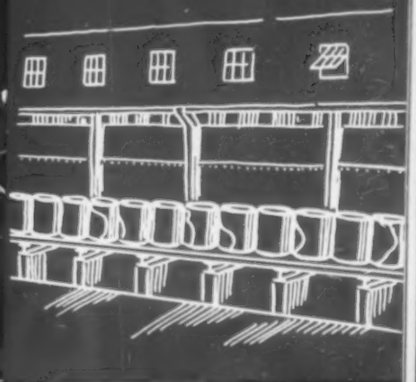
KANE & ROACH INC.

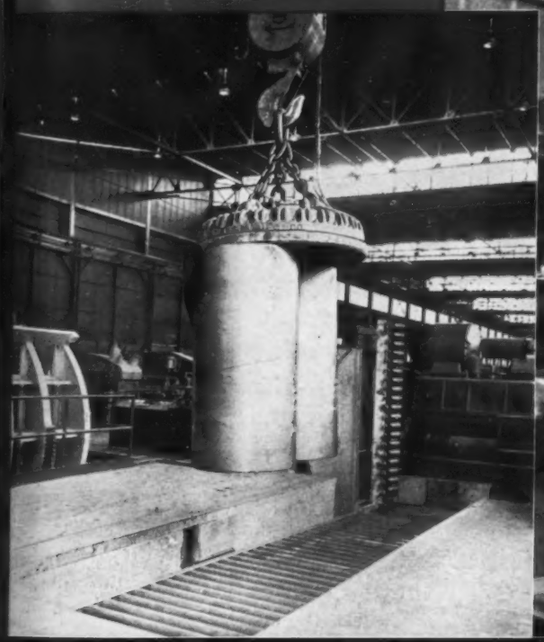
SYRACUSE, NEW YORK

WORLD'S LARGEST STRIP MILL *uses* EC&M MAGNETS









IN PICKLING DEPT. IN COLD MILL IN HOT COIL STORAGE

THE WIDEST and most modern strip mill in the world uses the world's most efficient method for handling TONS of STEEL in one lift—EC&M LIFTING MAGNETS. Being also the world's fastest, this mill turns out coils at a rapid rate and EC&M Smooth-Bottom Type SA Lifting Magnet keeps pace by taking 2 or 3 coils per lift from the hot mill conveyor and depositing them either in hot coil storage or at the up-ender at the beginning of the pickling line.

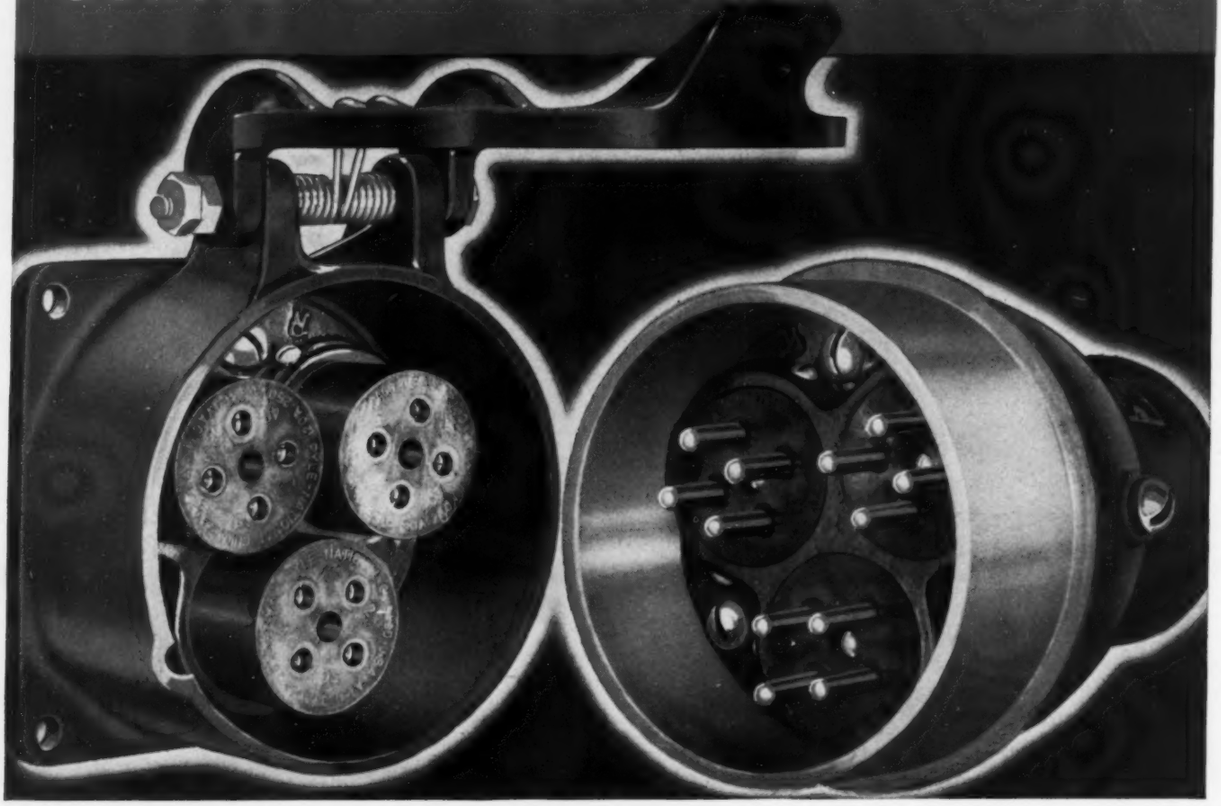
And in the cold mill, the latest development for handling cold mill coils—The New EC&M Type CSM Magnet is used. The advantages of the Type CSM(COLD STRIP MILL)Magnet for finished -coil handling are—Poles of magnet over coil—Magnetic flux concentrated in coil—Balanced load—Smaller and Lighter-weight magnet—Does not hide view of crane operator—Increases Storage Capacity, because coils can be stacked closer and piled higher without sacrificing ability to handle coils in and out of small space.

THE ELECTRIC CONTROLLER & MFG. CO. E&M CLEVELAND, OHIO

HEAVY DUTY MOTOR CONTROL FOR CRANES, MILL DRIVES AND MACHINERY • BRAKES • LIMIT STOPS • LIFTING MAGNETS AND AUTOMATIC WELD TIMERS.

Put your coil handling requirements up to EC&M

Flexible Control and Instrument Circuits



Multiple circuit plugs and receptacles, any combination 1 to 32 poles.

"QuelArc" circuit breaking plugs and receptacles, 2, 3, 4 poles rated 600 volts AC, 250 volts DC, 20, 30, 60, and 100 amperes.

simplify handling of heat treatment

Pyle-National plugs and receptacles provide for simple and rapid handling of temperature recording and control of portable annealing furnaces and other heat treating equipment. Multiple circuit plugs and receptacles for thermo-couple connections allow regular temperature recording plus rapid testing of temperatures at other locations in the furnaces whenever required. "QuelArc" plugs and receptacles for valve, light, blower, and other remote controls, concentrate control in one location and allow great flexibility in handling of portable equipment. The control and instrument panel is arranged so that any desired control or instrument circuit selection can be made merely by plugging in to receptacles on the panel.

Pyle-National plug and receptacle equipment is built for heavy-duty service. The complete line includes types for all needs, in capacities up to 100 amperes. Bulletins with complete listings will be sent upon request.

SPACE 115-116—IRON & STEEL EXPOSITION, CLEVELAND

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The Pyle-National Company, *General Offices and Works,* 1334-58 North Kostner Avenue, Chicago, Illinois • *Offices:* New York, Baltimore, Pittsburgh, St. Louis, St. Paul, San Francisco.

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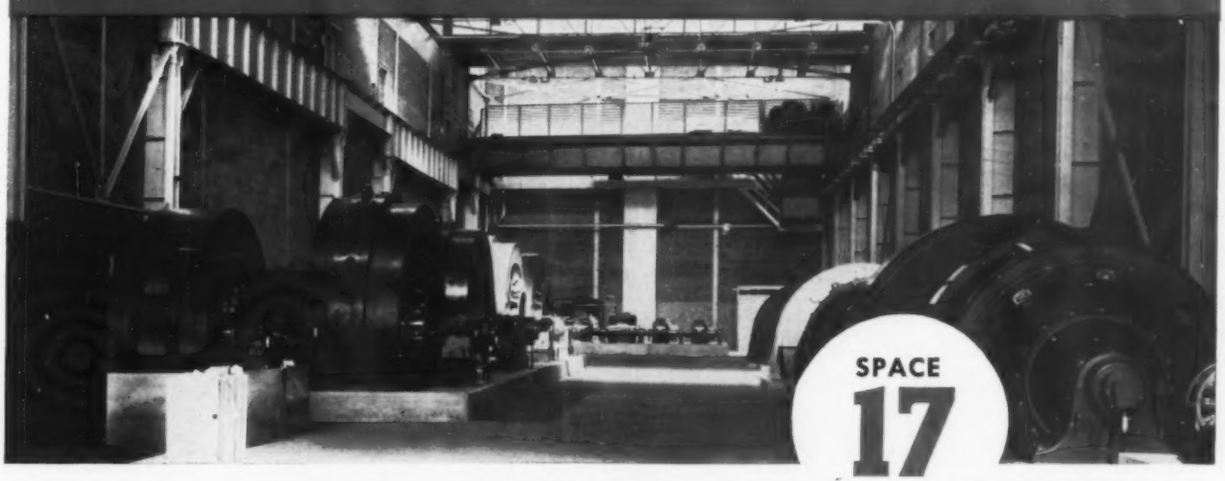
Le Carbone Brushes are made to the most exacting standards of quality and uniformity, to provide the highest standard of dependable, economical service even under continuous heavy loads and severe commutating conditions. The value of Le Carbone Brushes has been proved by years of dependable performance on all types of mill equipment where uninterrupted service is of greatest importance.

For specific recommendations consult Le Carbone engineers at the Iron & Steel Exposition, Cleveland.

LE CARBONE COMPANY, Inc.
BOONTON, NEW JERSEY
New York • Pittsburgh • Chicago • San Francisco

LE CARBONE BRUSHES



IRON & STEEL EXPOSITION ★ CLEVELAND

WAGNER HYDRAULIC-ACTUATED INDUSTRIAL BRAKES

Where Dependable Service is Essential — —

Specify Wagner Industrial Brakes

"The Hydraulic-Actuated Brake"

Low maintenance of cranes is assured if Wagner industrial brakes are made standard equipment for all steel mill bridge drives. Wagner industrial brakes are constructed to provide unusual accessibility to all parts — motor armature or brake wheel may be easily removed without disturbing any brake adjustments by simply removing only one pin. Ruggedness characterizes every detail of their construction — with welded steel parts, hardened pins and bushings, and cannonite brake wheels.

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For complete information, write to

Wagner Electric Corporation

INDUSTRIAL BRAKE EQUIPMENT

4902 Baum Blvd. · · · Pittsburgh, Pa.

I38-1

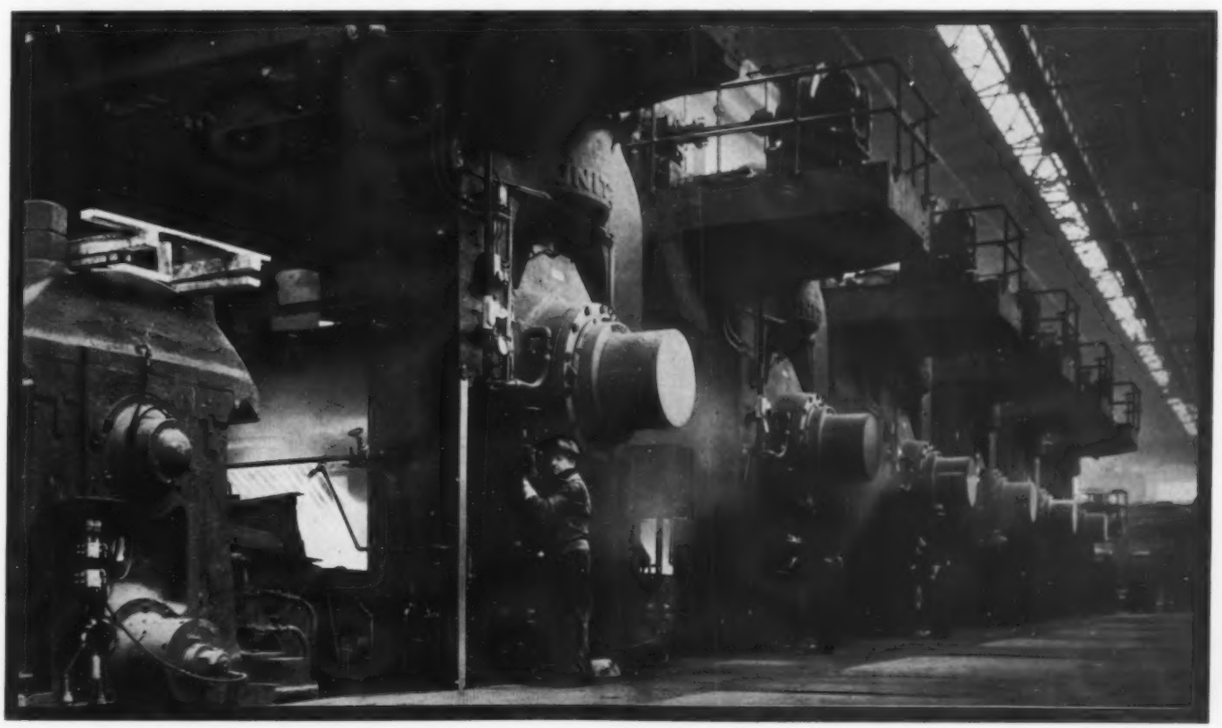
INSPECTION TRIP

Wednesday - September 28 - 1:00 P. M.

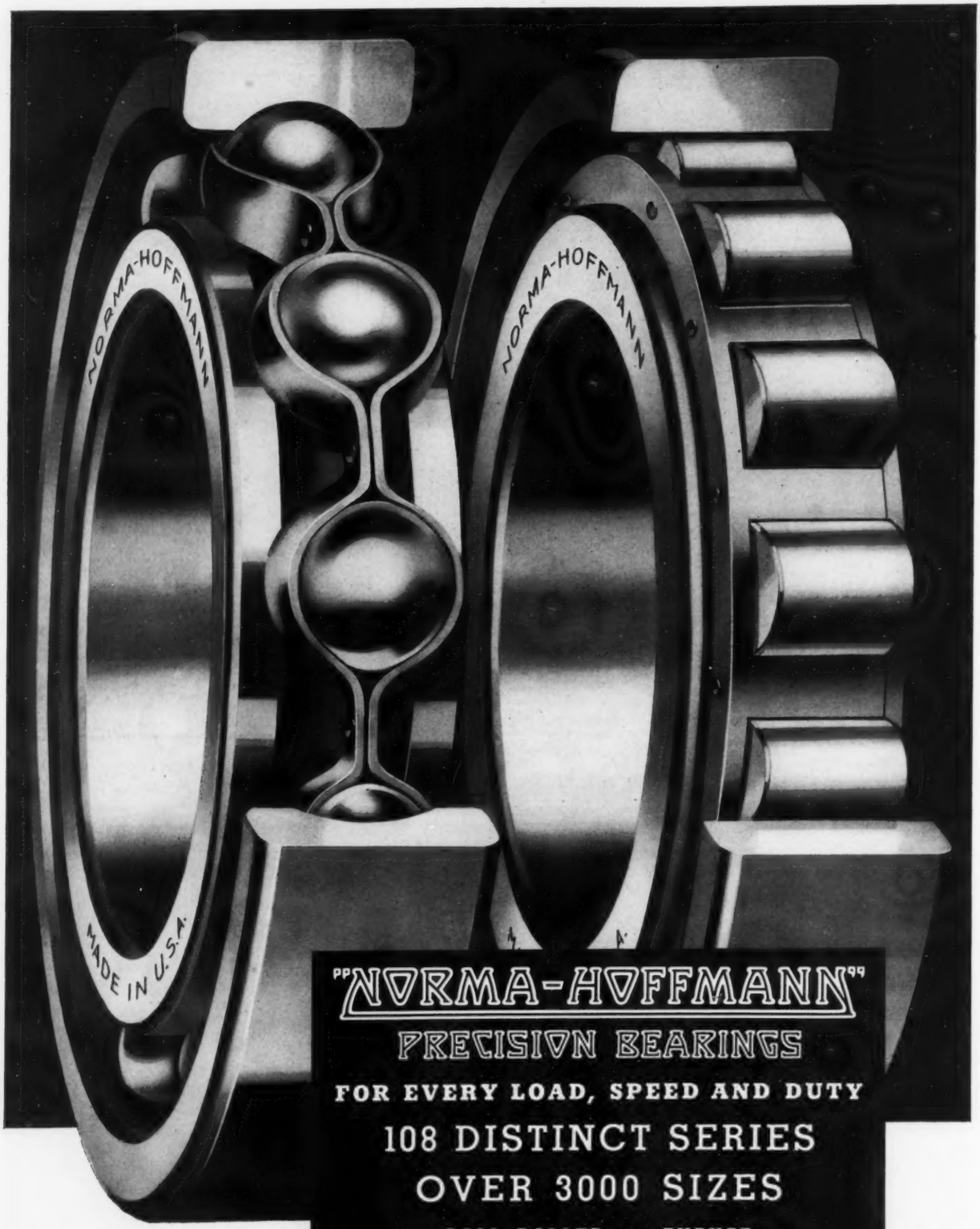
98" Continuous Hot and Cold Strip Mill
REPUBLIC STEEL CORPORATION

Buses will leave the Cleveland Public Auditorium at 1:00 P. M. It is requested that the members and guests assemble about fifteen minutes previous to that time so that a group picture may be taken. Also it must be remembered that no private cars will be admitted to the plant, making the use of the buses mandatory. Tickets will be available only at the registration headquarters in the Cleveland Public Auditorium. . . . . .

Finishing Stands Republic Steel Corp's 98" Continuous Strip Mill



ADVERTISING PAGES REMOVED



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FOR EVERY LOAD, SPEED AND DUTY

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REPUBLIC STEEL CORPORATION

GENERAL OFFICES: REPUBLIC BUILDING

CLEVELAND, OHIO

T. M. GIRDLER
CHAIRMAN OF BOARD

August 19th, 1938

Association of Iron & Steel Engineers,
Empire Building,
Pittsburgh, Pennsylvania.

Gentlemen:

On behalf of the iron and steel industry of Northern Ohio, I heartily welcome you to Cleveland on the occasion of your 34th Annual Convention and Iron and Steel Exposition to be held here September 27, 28, 29 and 30.

The world owes much to you whose lives are devoted to the practical problems involved in improving steel and steel-making methods. Your tireless work in constantly developing new and better processes for improving steel products and lowering their cost is continually adding to the convenience and comfort and safety of living.

Such accomplishment as the development of the modern continuous strip mill which stands as a mighty monument to the co-ordinated work of electrical, mechanical, metallurgical, hydraulic and lubrication engineers, has turned the luxuries of the few into the necessities of the millions. The high quality, remarkable workability and low cost of strip steel today have been an essential factor in the development of the automobile, the refrigerator, electric appliances, air conditioning, and countless other conveniences which are so much a part of our modern life.

It is fitting that the Association should again return to Cleveland at this time. Here, in the heart of one of the world's greatest steel centers you will find our industry's latest great achievement, the 98 inch continuous strip mill, the world's largest.

We trust that your meetings will be successful in every respect and sincerely hope that your visit will be a most profitable, interesting and pleasant one.

Sincerely,

Tom M. Girdler

TMG:FIR

L. F. Coffin

PRESIDENT

A. I. & S. E.

WITH the opening of its thirty-fourth Convention and Iron and Steel Exposition, the Association of Iron and Steel Engineers is pleased to greet its members and friends in the iron and steel industry, and to cordially invite them to participate fully in its various activities.

We believe we can truthfully say our technical program this year is the best we have ever presented. It is well-rounded, and covers authoritatively the latest developments in steel plant engineering. In the Iron and Steel Exposition will be exhibited the latest designs of the leading manufacturers of steel plant equipment.

The personnel of the steel industry cannot afford to ignore the advantages offered by these two features, with their splendid opportunities for broadened vision and new channels of thought, and it is with pleasant anticipation that we look forward to welcoming the progressive engineers and operators of the industry.

CONVENTION COMMITTEES

GENERAL CHAIRMEN OF CONVENTION AND EXPOSITION

Chairman
L. F. COFFIN,
Supt. Mech. Dept.,
Bethlehem Steel Co.,
Sparrows Point, Md.

Vice Chairman
J. L. MILLER,
Asst. Chf. Comb. Engr.,
Republic Steel Corp.,
Cleveland, Ohio.

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Asst. Gen. Mgr.,
Algoma Steel Corp.,
Saulte Ste. Marie,
Ontario, Canada.

Vice Chairman
H. G. R. BENNETT,
Asst. General Supt.,
Carnegie-Illinois Steel
Corporation,
Duquesne, Penna.

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Bethlehem Steel Company,
Sparrows Point, Maryland.

REGISTRATION COMMITTEE

Chairman
F. W. LORIG,
Chief Draftsman,
American Steel & Wire Co.,
Cleveland, Ohio.

Vice Chairman
THOMAS B. MCELRAY,
Supt. Electrical Dept.,
Carnegie-Illinois Steel
Corp.,
Youngstown, Ohio.

LOCAL CLEVELAND SECTION ENTERTAINMENT COMMITTEE

A. H. SWARTZ, *Hon. Chairman*

W. W. SPANAGEL, *Chairman*

HARRY J. FISHER, *Vice Chairman*

IRON & STEEL EXPOSITION COMMITTEE

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JULIUS CLAUSS,
Chief Engineer,
Great Lakes Steel Corp.,
Ecorse, Michigan.

Vice Chairman
D. M. PETTY,
Div. Supt., Lehigh Plant,
Bethlehem Steel Company,
Bethlehem, Penna.

LADIES CARD PARTY

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J. W. COREY
H. J. FISHER
A. L. FOELL
J. J. MELLON
J. L. MILLER
J. P. MOORE
H. L. SHEPARD
L. A. TERRY
E. J. WAGAR

COMMITTEE ON ATTENDANCE

Chairman
W. A. PERRY,
Supt. Elec. & Power Depts.,
Inland Steel Company,
East Chicago, Ind.

Vice Chairman
A. W. STEED,
Maintenance Supt.,
American Rolling Mill Co.,
Middletown, Ohio.

EXHIBITORS DANCE

T. B. MCELRAY—*Chairman*
C. E. BUCHAN
GEORGE V. CRIPPS
R. R. DAY
CHARLES DEAN
HARRY EASTWOOD
G. N. HARMON
J. M. IRELAND
PAUL LARSON
GEORGE H. ROSE
V. F. WALTERS

EXHIBITORS INFORMAL DANCE COMMITTEE

Chairman
THOMAS B. MCELRAY, Supt. Elec. Dept.
Carnegie-Illinois Steel Corporation,
Youngstown, Ohio.

LADIES SIGHT SEEING TRIP

I. N. TULL—*Chairman*

H. T. FLORENCE
R. A. GEUDER
S. L. HENDERSON
F. D. JOHNSON
L. W. LONG
D. MARTIGNONE
C. W. PHILLIPS
A. C. SHEPHERD
W. H. WILLIAMS
J. E. WOOD

All ACTIVITIES

Tuesday, September 27

9:00 A. M.

Main Lobby

REGISTRATION

CHAIRMAN	VICE CHAIRMAN
FRANK W. LORIG, Chief Draftsman, American Steel and Wire Company, Cleveland, Ohio.	THOMAS B. MCELRAY, Superintendent Electrical Department, Carnegie-Illinois Steel Corporation, Youngstown, Ohio.

9:15 A. M.

BUSINESS SESSION

Club Room B

CHAIRMAN	VICE CHAIRMAN
LOUIS F. COFFIN, Superintendent Mechanical Department, Bethlehem Steel Company, Sparrows Point, Maryland.	JAMES L. MILLER, Assistant Chief Combustion Engineer, Republic Steel Corporation, Cleveland, Ohio.

Annual Meeting and Business Session of Association of Iron and Steel Engineers.

9:30 A. M.

Club Room B

ELECTRICAL ENGINEERING DIVISION

CHAIRMAN	VICE CHAIRMAN
JOHN W. BATES, Electrical Engineer, Const. Eng. Div. Carnegie-Illinois Steel Corp., Pittsburgh, Pa.	FRED O. SCHNURE, Electrical Superintendent, Bethlehem Steel Co., Sparrows Point, Md.

"A Study of the Requirements of 440-Volt, A-C Motor Control for Steel Mills" by Donald C. Nelson, Assistant Electrical Engineer, and J. Russell Powell, General Foreman, Jones and Laughlin Steel Corporation, Pittsburgh, Pennsylvania.

"Performance of Slabbing Mill Auxiliary Drives with Ward-Leonard Control" by W. A. Perry, Superintendent, Electric and Power Departments, Inland Steel Company, and W. B. Snyder, Industrial Engineering Department, General Electric Company.

Official Opening—Iron and Steel Exposition 1:30 P. M.

1:30 P. M.

Club Room B

METALLURGICAL AND WELDING ENGINEERING DIVISION

CHAIRMAN	VICE CHAIRMAN
CHARLES L. MCGRANAHAN, Assistant General Superintendent, Jones and Laughlin Steel Corporation, Pittsburgh, Pa.	JOHN S. KENNEY, Superintendent Cold Strip Mills, Wheeling Steel Corporation, Yorkville, Ohio.

"Continuous Pickling of Wide Strip Steel with Flash Welding" by L. R. Milburn, Engineer, Great Lakes Steel Corporation, Ecorse, Michigan.

2:30 P. M.

METALLURGICAL ENGINEERING DIVISION

"Electrolytic Pickling of Strip Steel" by H. W. Neblett, Engineer, Inland Steel Company, East Chicago, Indiana.

"Pickling of Strip Steel From the Metallurgical Point of View" by H. P. Munger, Metallurgist, Republic Steel Corporation, Warren, Ohio.

WELDING ENGINEERING DIVISION

Club Room A

CHAIRMAN	VICE CHAIRMAN
G. A. HUGHES, Electrical Engineer, Truscon Steel Company, Youngstown, Ohio.	WRAY DUDLEY, Electrical Superintendent, National Tube Company, McKeesport, Pennsylvania.

"European Welding Practice and American Trends" by C. H. Jennings, Research Engineer, Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pennsylvania.

"Welding as Used in Industrial Plants" by Dr. Gilbert Doan, Lehigh University, Bethlehem, Pennsylvania.

VISIT THE IRON AND STEEL EXPOSITION

2:00 - 5:00 P. M.

LADIES CARD PARTY AND TEA

Hotel Statler—Pine Room

7:00 P. M.

VISIT TO IRON AND STEEL EXPOSITION

10:00 P. M.

EXHIBITORS' DANCE—INFORMAL

Hotel Statler—Euclid Ballroom

Wednesday, September 28

9:00 A. M.

Club Room B

MECHANICAL ENGINEERING DIVISION

CHAIRMAN	VICE CHAIRMAN
J. A. CLAUSS, Chief Engineer, Great Lakes Steel Corporation, Ecorse, Michigan.	R. R. THOMAS, Assistant Chief Engineer, Tennessee Coal, Iron and Railroad Company, Ensley, Alabama.

"Finishing Equipment for Wide Strip Mills" by John L. Young, Manager Machinery Sales, United Engineering and Foundry Company, Pittsburgh, Pennsylvania.

"Modern Blooming Mill Design" by Lorenz Iversen, President, Mesta Machine Company, Pittsburgh, Pennsylvania.

"Brief Review of Developments in the Flat Rolling of Steel" by Stephen Badlam, Consulting Engineer, Pittsburgh, Pennsylvania.

1:00 P. M.

Inspection Trip: 98" Hot and Cold Strip Mill, Republic Steel Corporation, Cleveland, Ohio. Buses will depart from the Cleveland Public Auditorium.

2:00 P. M.

LADIES' SIGHT-SEEING TRIP

UNDER One ROOF

Thursday, September 29

9:00 A. M.

Club Room B

ELECTRICAL ENGINEERING DIVISION

CHAIRMAN	VICE CHAIRMAN
GEORGE R. CARROLL, Assistant Maintenance Superintendent, Jones and Laughlin Steel Corporation, Aliquippa, Pennsylvania.	W. A. PERRY, Superintendent Electric and Power Departments, Inland Steel Company, East Chicago, Indiana.

"Acceleration of Tandem Cold Strip Mills" by T. R. Rhea and M. J. Leding, Engineers, General Electric Company.

"Low Voltage Rectifiers for Industrial Requirements" by G. E. Stoltz, Manager, Metal Working Section, Westinghouse Electric & Mfg. Company, and J. H. Cox, Manager, Rectifier Engineering Department, Westinghouse Electric & Mfg. Company, East Pittsburgh, Pennsylvania.

9:00 A. M.

Club Room A

COMBUSTION ENGINEERING DIVISION

CHAIRMAN	VICE CHAIRMAN
M. J. CONWAY, Fuel Engineer, Lukens Steel Company, Coatesville, Pennsylvania.	F. E. LEAHY, Fuel Engineer, Youngstown Sheet and Tube Company, Youngstown, Ohio.

"Standardization of Steel Plant Fuel Accounting and Test Procedure for Fuel Consumption Determination" by H. V. Flagg, Combustion Engineer, American Rolling Mill Company, Middletown, Ohio.

"Oil Burning and Its Control" by A. J. Fisher, Fuel Engineer, Bethlehem Steel Company, Sparrows Point, Maryland.

"Use of Mixed Gases for Steel Mill Operations" by E. T. W. Bailey, Combustion Engineer, Steel Company of Canada, Ltd., Hamilton, Ontario, Canada.

2:00 P. M.

Club Room A

LUBRICATION ENGINEERING DIVISION

CHAIRMAN	VICE CHAIRMAN
C. C. PECU, Lubrication Engineer, Bethlehem Steel Company, Lackawanna, New York.	FRANK THOMAS, Lubrication Engineer, Republic Steel Corporation, Cleveland, Ohio.

"Design and Lubrication of Gears and Pinions" by Clark Johnson, Manager, Gear Department, United Engineering and Foundry Company, Pittsburgh, Pennsylvania.

"American and European Lubrication Practice for Steel Mills" by R. M. Gordon, Gordon Lubricators Division, Blaw--Knox Company, Pittsburgh, Pennsylvania.

"Lubrication Problems of Modern Continuous Rolling Mills" by L. Ballard, Supervising Industrial Engineer, Tide Water Associated Oil Company, New York, New York.

2:00 P. M.

Club Room B

MECHANICAL ENGINEERING DIVISION

CHAIRMAN	VICE CHAIRMAN
H. G. R. BENNETT, Assistant General Superintendent, Carnegie-Illinois Steel Corporation, Duquesne, Pennsylvania.	C. P. BETZ, Superintendent Coke Plant, Hanna Furnace Division, Great Lakes Steel Corporation, Ecorse, Michigan.

"Design and Operation of the Modern Blast Furnace" by J. C. Barrett, Carnegie-Illinois Steel Corporation, Youngstown, Ohio.

"Modern Coke Oven Design and Practice" by Fred Denig, Vice President, Engineering and Construction Division, Koppers Company, Pittsburgh, Pennsylvania.

VISIT THE IRON AND STEEL EXPOSITION
Exposition open from 10 A. M. to 5:30 P. M.

6:30 P. M.

FORMAL BANQUET AND DANCE

Hotel Statler.

Main Ball Room

SPEAKERS—T. M. GIRDLER, Chairman of the Board, Republic Steel Corporation, and "SENATOR" EDWARD FORD, New York City.

Friday, September 30

9:00 A. M.

Inspection Trip: Fisher Body Plant, General Motors Corporation, Cleveland, Ohio. Buses will depart from Cleveland Public Auditorium.

VISIT THE IRON AND STEEL EXPOSITION
Exposition Open From 10 A. M. to 4 P. M.

PERTINENT DETAILS

All of the events of the Convention and Exposition, with the exception of the social functions, will be held in the Cleveland Public Auditorium. This is in line with the policy the Association has been seeking to maintain at its Annual Conventions, in having all activities under the one roof. The Inspection Trips which will be held to Republic Steel Corporation's new hot strip mill, and the Cleveland Plant of the Fisher Body Company will depart from the Public Auditorium. The social affairs will all be held at the Hotel Statler, which will be the headquarters Hotel.

. . . Don't Fail to Visit the

CLEVELAND PUBLIC AUDITORIUM

SEPTEMBER 27 - 28 - 29 - 30

In the Cleveland Public Auditorium, which is housing the Convention activities as well, over 100 manufacturers of steel mill equipment have spent thousands of dollars in arranging to display the latest in design and equipment for manufacturing and processing steel. It will be an Exposition which every steel mill man should visit time and again as there are many features of this Show which will be instructive and helpful in solving every day problems. On the following two pages will be found a tabulated list of those companies cooperating to make this great Exposition.

Sponsored by ASSOCIATION of IRON and STEEL ENGINEERS

General views of 1937 EXPOSITION held in Chicago, Illinois

the Iron and Steel Exposition

One of the outstanding exhibits of the Iron and Steel Exposition will be an animated model of a new seamless tube mill recently installed by the Youngstown Sheet and Tube Company, Youngstown, Ohio. Plans for this model mill were converted into proper scale by the employees of the Youngstown Sheet and Tube Company. It was constructed in its entirety, with the exception of the casting of the housing, by the skilled mechanics who are employed in the pattern shop and machine shops. The model, which is a reproduction constructed on a scale of one inch to the foot, will actually roll lead pipe from lead billets.

The new mill, of which the model is a replica, is the first large seamless tube mill built in this country in over seven years. All the latest developments in mechanical and electrical design are incorporated in the new equipment, from blooming mill to automatic pipe length recorders. Construction and rolling principles used in modern continuous strip mills have been applied in the design of the mill, which has a rated capacity of 300,000 tons per year. The new mill is part of a general development and improvement program just completed in Youngstown Sheet and Tube's seamless pipe division.

At the IRON & STEEL EXPOSITION you will see this animated model of Youngstown Sheet & Tube Co's. new seamless tube mill actually roll pipe

EXPOSITION HOURS

TUESDAY, SEPT. 27—1:30 P. M. to 5:30 P. M.
7:00 P. M. to 10:00 P. M.

WEDNESDAY, SEPT. 28—10:00 A. M. to 10:00 P. M.

THURSDAY, SEPT. 29—10:00 A. M. to 5:30 P. M.

FRIDAY - SEPT. 30—10:00 A. M. to 4:00 P. M.

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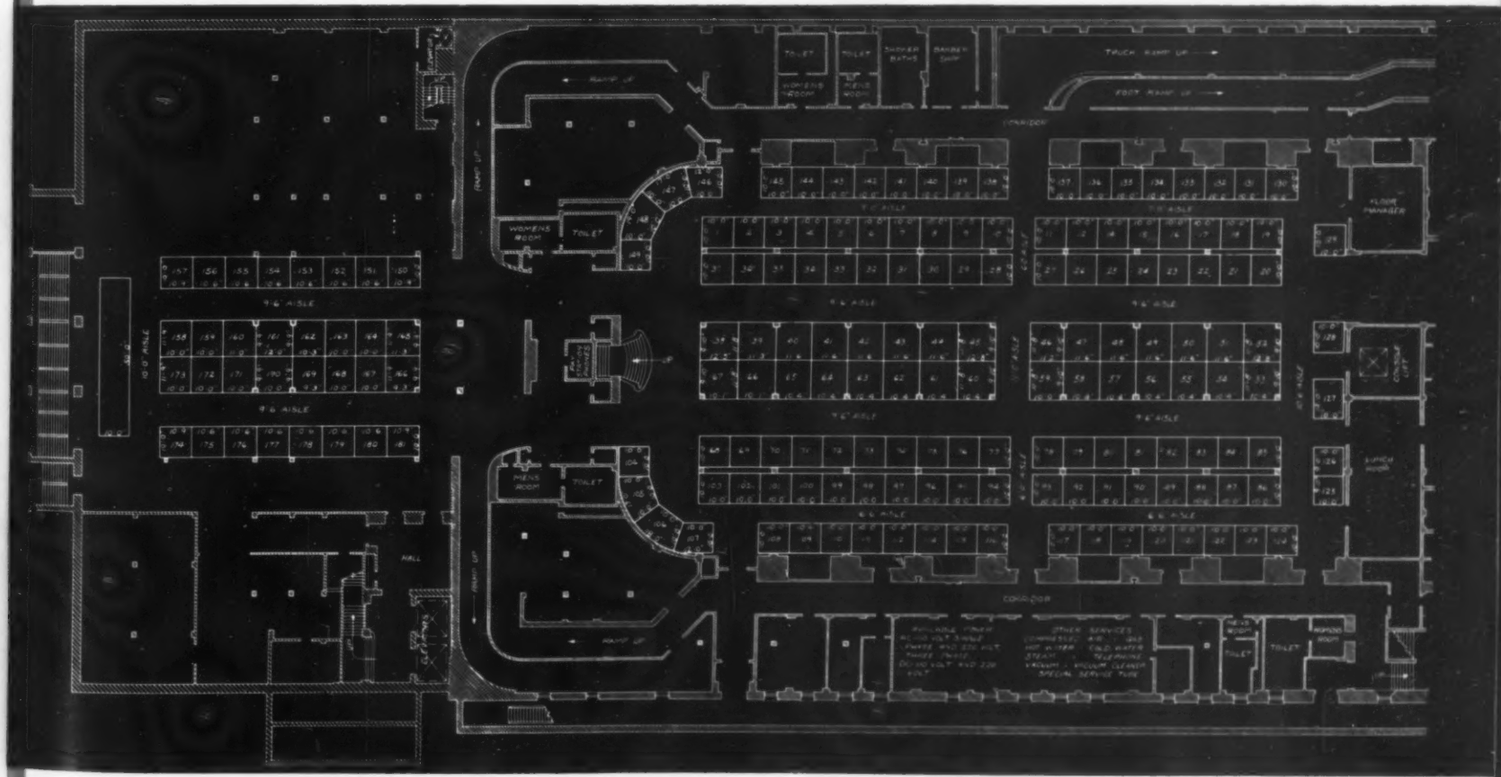

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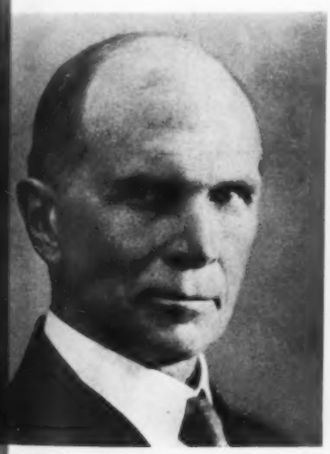

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INSPECTION TRIPS

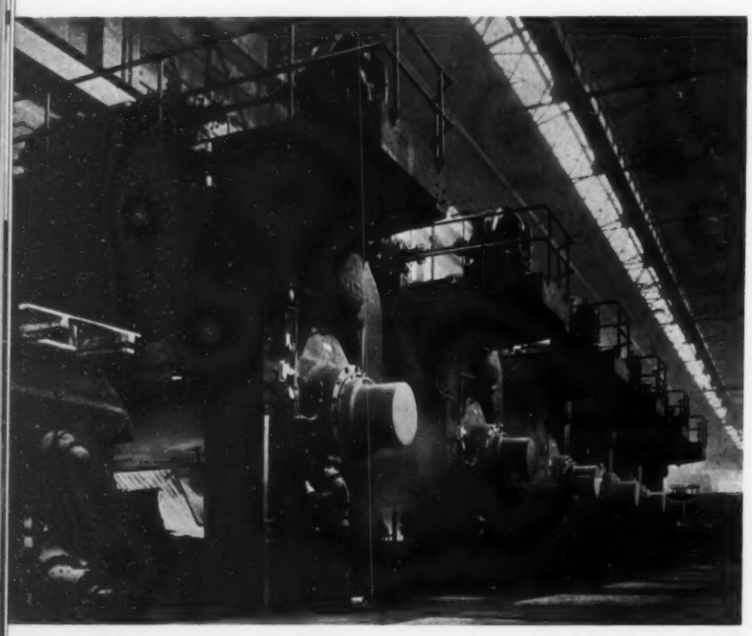
REPUBIC STEEL CORP.

Wednesday, September 27

The inspection trip to the new 98″ continuous hot and cold strip mills of the Republic Steel Corporation will originate at the Cleveland Public Auditorium. The first bus will depart at 1:00 P.M. Officials of the Republic Steel Corporation have requested those making the trip to use the special transportation facilities that will be provided by the Association, otherwise they will not be permitted to enter the plant.

Tickets for this trip will be on sale at the registration desk in the Cleveland Public Auditorium after 1:00 P.M. Tuesday, September 27.

The train of six hot mill finishing stands of Republic Steel Corporation's new strip mill at Cleveland, Ohio. This mill, the largest and fastest in the world will be inspected by members and guests of the A. I. & S. E. on Wednesday, September 28.

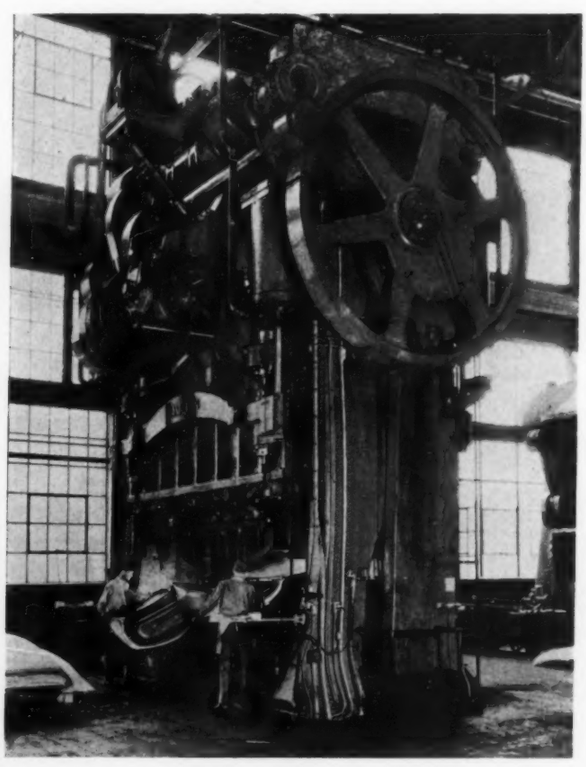


FISHER BODY CO.

Friday, September 29

The same general plan used in connection with the Republic trip will be in effect for the trip to the Cleveland plant of the Fisher Body Company on Friday morning, September 30. The first bus will depart from the Public Auditorium at 9:30 A.M., and everyone making the trip must use these special facilities. Tickets for this trip will also go on sale Tuesday at 1:00 P.M.

This triple action deep drawing press operates at a speed of 280 strokes per hour. Members and guests of the Association will see presses of this type in action during their trip to the Cleveland plant of the Fisher Body Company on Friday, September 30.



Air Conditioning

..AS RELATED TO..

STEEL PRODUCTS WAREHOUSES

By C. W. DAUBERT, Engineer

Operating Department

CARNEGIE-ILLINOIS STEEL CORP.

PITTSBURGH, PA.

Presented before the A. I. & S. E. Pittsburgh District Section, February 25, 1938

▲ AIR conditioning may in general be considered as the control of the atmosphere in a building or enclosure with reference to temperature, moisture content or humidity, air movement, and the removal of dust or undesirable vapors or odors. These various requirements may involve the use of heating, refrigeration, fans, filters, electrical precipitators, drying by absorption, and other methods or equipment. Any or all of the apparatus mentioned may be used, depending upon the requirements at the point of use. Expenditures for equipment may involve large sums of money.

TEMPERATURE AND HUMIDITY

In many industrial applications, control of temperature and humidity alone is important, so as to insure control of the quality of product and the continuity of manufacture. This is particularly true of materials which are hygroscopic; that is, materials which take up or give off moisture to the atmosphere, depending upon the temperature and humidity of the atmosphere. Such materials include textiles, paper, certain foods, tobacco and leather among many others.

Preservation of materials in storage is also dependent upon holding a proper combination of humidity and temperature in storage rooms and buildings, and the materials mentioned come within this classification. The preservation of other materials in storage is dependent only upon limiting the relative humidity or moisture content of the air to a maximum. This maximum must be sufficiently below the dew point to preclude the possibility of moisture from the atmosphere being condensed upon the product.

The term "relative humidity" is very generally used to denote the water vapor content of unsaturated air with relation to a specific air temperature which may be under consideration. It is the ratio of such vapor pressure to the vapor pressure of the air when saturated at that temperature, and is customarily shown as a percentage of the saturation vapor pressure. For present purposes, the term "relative humidity" may be considered to be the ratio of the water vapor actually present to the greatest amount the air under consideration could contain at a specific temperature.

Engineering handbooks, and books on heating, ventilating and air conditioning provide detailed data on the subject. They generally contain psychrometric tables and charts which show the percentage relative humidity, actual moisture content, and saturation point for a wide range of temperatures.

Coming within the classification of products which can be controlled by limitation of the moisture content of the atmosphere in the storage buildings are iron and steel. It is with these products that this discussion is concerned, and the term "steel" will be used hereafter to designate the materials.

It is generally known, of course, that the greatest loss in storage is caused by corrosion resulting from the rusting of the steel in the presence of water. This is particularly true where steel surfaces carry very thin protective oxides or are polished. Large heavy sections or products which are roughly finished and carry a heavy blue protective oxide from the manufacturing process are ordinarily further protected by painting, oiling or greasing, and it is not necessary to store them in heated buildings. Lighter products such as wire, strip and cold rolled steel which may have highly finished surfaces are quite often protected by oiling and wrapping tightly in paper or cloth.

Steel products which are produced and stored in large quantities and require the maximum possible protection while in storage are black and coated sheets and plate. For the purpose of simplicity "black sheets" will be understood to include deoxidized or bright an-

nealed sheets as well as those carrying a blue oxide, and "coated sheets or plate" will include galvanized sheets and tin or terne plate.

At times a single plant may have many thousands of tons of black or coated products in storage. Surface requirements for these products are very rigid. Every precaution must be taken to eliminate rusting in the case of black sheets, or surface oxidation and discoloration in the case of coated products, if large expenditures for reconditioning or losses due to possible scrapping of the stock are to be avoided.

TYPE OF STORAGE BUILDING

Warehouses for the storage of black and coated products, specifically sheet and tin plate products, should be of substantial construction with tight windows and doors. It is essential that leakage of air from the outside be held to a minimum when winds are prevalent, and that the construction and materials be such as to minimize heat losses.

The importance of insulating roofs and portions of their supporting steelwork should not be overlooked. Uninsulated roofs are a considerable source of trouble during cold weather due to condensate forming on them and dropping onto the stock below.

HEATING SYSTEM

A definite requirement for warehouses storing black and coated sheets and plate is an adequate heating system. The system should have sufficient capacity to be capable of heating the air in the building at least 10 degrees F., per hour. Some means of forced circulation of the heated air should be provided so that efficient transfer of heat to the stock may be obtained and its temperature increased with a minimum loss of time. Steam coils or radiators at the walls which depend primarily upon the action of convection currents for heat distribution have been found unsatisfactory. The action is very slow and the greater portion of the heat is delivered to the roof instead of to the mass of steel stored on the floor.

HEAT DISTRIBUTION

Forced circulation of heated air either through ducts or from unit heaters has been found most satisfactory. In either case the ducts should discharge horizontally along the floor, and the air should be recirculated 100 per cent. Where a central heating system is installed the main ducts should be carried under the floor along the sidewalls of the building, with outlets at frequent intervals. The outlets should be oblong in shape and discharge across the floor toward the center of the building. Warehouses which are equipped with overhead ducts from a central system may have the outlet ducts carried to the walls and extended to the floor to discharge as previously mentioned.

Where unit heaters are preferred, they should be placed along the walls and be of the bottom discharge type.

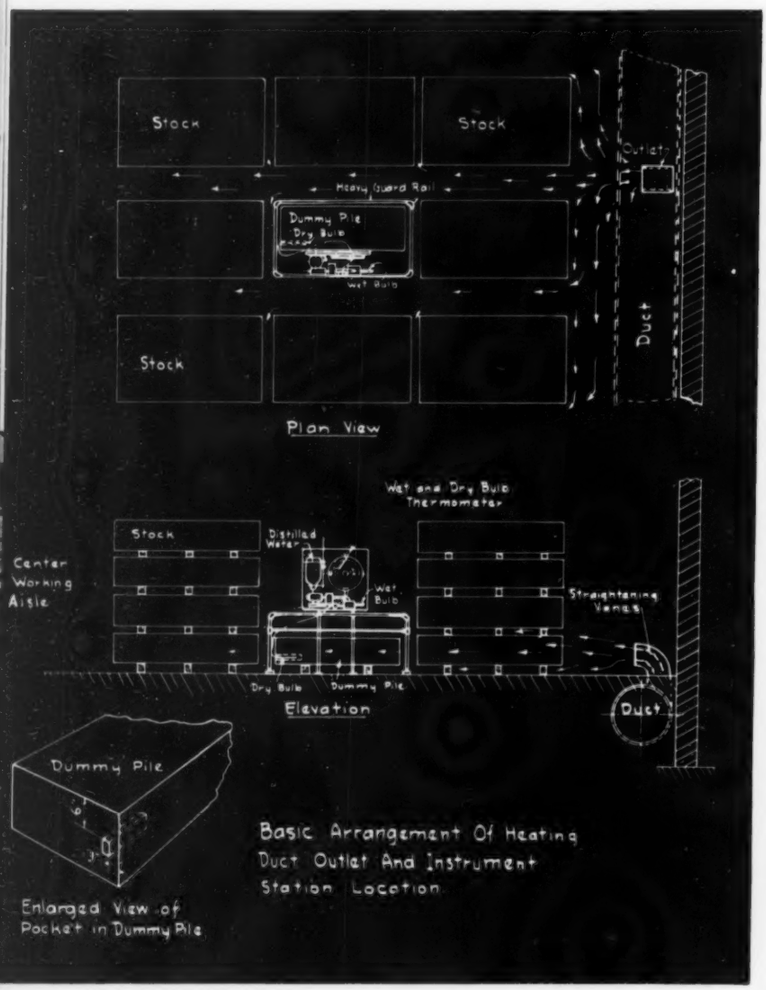
The advantages of the floor level discharge outlets are that the heated air is delivered at maximum velocity to the location which is always the most difficult to heat, and most important, the temperature of the heavy mass of stock itself is most quickly affected.

The number of door openings should be kept to the minimum consistent with effective handling of the stock for storage and shipment. All large doors leading to loading platforms, or to other unheated buildings, should have a discharge outlet on each side of the door. This is of particular importance where the doors serve loading platforms that are not protected from the weather, as outlets at the doors modify the cold or moist air before it penetrates far into the building.

In placing the stock in the warehouse it is desirable that aisles be arranged in front of the duct outlets so that heated air may be able to circulate readily among the various stock piles. If it is possible to place spacers in the piles as they are built up, this will also aid in permitting circulation through the mass of steel.

Instrument requirements for black and coated plate warehouses are rather simple. There need be no more than a thermostat for controlling the air temperature, and a hygrometer to measure the relative humidity or

Basic arrangement of heating duct outlet and instrument station location.



a wet and dry bulb thermometer to determine the saturation temperature of the air.

Where unit heaters are installed, thermostats are useful in maintaining minimum temperatures in the areas served by the individual heaters. However, where central heating systems are used to serve warerooms or portions of large warerooms through ducts it is difficult to select a regulating point which is satisfactory for the control of such large systems.

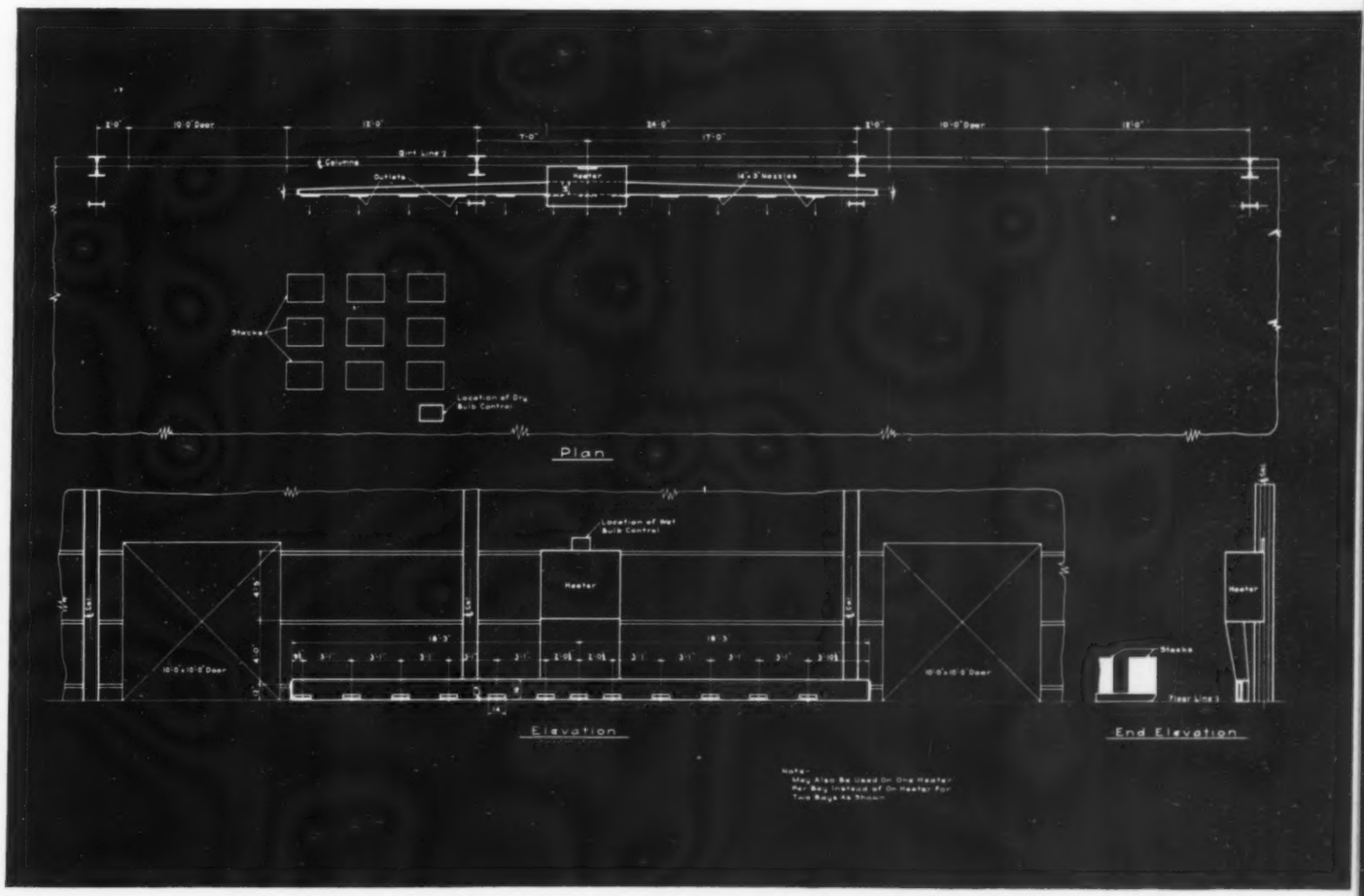
Hygrometers show directly the percentage relative humidity and may be either indicating, recording, or recording and controlling. In steel storage warehouses, the maintenance of a specific relative humidity is not as important as is the case in the textile, paper, food and other industries previously mentioned. Hygrometers are probably more difficult to keep in accurate calibration than standard types of thermometers because of the rather delicate measuring elements required.

Wet and dry bulb thermometers, which are also known as psychrometers, are two thermometer units adjacent to each other. They show the actual temperature of the air by means of the dry bulb, and the temperature at which that same air would be saturated with water vapor by means of the wetted bulb. They may also be indicating, recording, or recording and controlling.

The wet and dry bulb thermometer is preferred to the hygrometer because of its greater ruggedness when installed where steel is handled, and also its stability under vibration from cranes. It should be the recording type. Its greatest usefulness, however, comes from the ability to use the dry bulb for measuring the temperature of the steel itself by inserting the bulb in a pile of sheets. This gives a direct measure of the margin of safety in degrees of temperature between the stock and the saturation temperature of the air in the warehouse as determined by the wet bulb. It will be noted that it is not necessary to calculate or know the relative humidity. It is necessary only to see that a proper minimum temperature differential is maintained between the two pens to prevent the temperature of the stock from dropping to the point where moisture will be condensed on the steel from the surrounding atmosphere.

In large warerooms, several of the wet and dry bulb recorders should be provided, as appreciable differences in temperature and humiidity may exist between different parts of the building, especially at floor level. One instrument at least should be mounted near a fre-

Diagrammatic sketch of warehouse heating system showing method of distributing hot air from unit heaters.



quently used door, and another in a quieter section so that the general condition of the entire stock may be known.

The instruments may be mounted either on the building walls, or on a panel board supported by a heavy pipe or angle iron structure with a guard rail located among the piles of stock. In the latter case the heavy protection is necessary to minimize injury to the equipment if accidentally bumped by a tractor or crane load.

If wall mounted, the dry bulb of the instrument should be provided with a capillary tube 20 to 25 feet long so that the bulb may be placed in a pile of sheets or plate. The capillary tube should cross aisles or runways at the side of the building under the floor for protection against injury. If the instrument is located on a panel board in the stock, the dry bulb capillary need not be over five or six feet long, as it can be inserted in a dummy pile of plate which may be left permanently under the instrument and within the guard rail. The best location for the dry bulb is not in the center of the dummy pile but in a slot or picket cut into the pile near one edge and near the floor level. Changes in the temperature of the stock are detected most quickly in this manner.

The wet bulb of these instruments may be covered either by a porous tube or by a wick. To prevent erroneous wet bulb readings the porous tube should be cleaned or the wick renewed frequently. Distilled water is recommended for the wet bulb water supply to prevent a deposit of incrusting salts resulting from the evaporation of water obtained from customary sources.

The motor driving the blower for the wet bulb should be of ample size and rugged construction with good bearings, and be built to operate 365 days per year. The instrument is of use only in proportion to its ability to stay in continuous service. It should be inspected and checked periodically so that its records may be relied upon.

OPERATION OF SYSTEM

Responsibility for the protection of the stock against rusting should be placed upon the superintendent or foreman in charge of the warehouse. In the northern and eastern parts of the country warehouses containing black and coated plate stocks are usually heated continuously during the winter months, and the temperature of the stock is considerably above the danger point. Where it is necessary to have several doors open to unsheltered loading platforms at one time during cold weather, a considerable amount of protection can be given by building up a temperature head in the stock. This may be done by operating the heating system at a good rating during the night with the building tightly closed.

In the northern and eastern regions the greatest trouble with sweating is encountered during the late Spring, Summer and early Autumn months, while in the warmer southern and west coast regions the danger is great throughout the year. This is particularly true in warehouses located near large bodies of water such as the Great Lakes, Oceans, and the Gulf. A cool night could chill the stock and, if followed by a warm humid day, there would be a great increase in the moisture content of the atmosphere. A sudden shift in wind direction may also accomplish this. As the wet bulb pen is always a considerable distance below the dry bulb pen during periods of low humidity, an increase in the humidity will cause the wet bulb temperature to approach that of the dry bulb. The rate of approach will tell the warehouse man when and at what rate it is necessary to operate the heating system. Operation of the heating system helps in two ways—first, by increasing the temperature of the stock itself and, second, by moving and warming the air in the warehouse so that it can be considerably reduced in temperature while in contact with the stock without reaching its dewpoint.

The wet bulb of the instrument should be provided with a motor driven blower of adequate capacity to circulate continuously past the bulb an appreciable sample of the air in the building. By experience it has been found that the heating system should be started when the wet bulb temperature approaches to within approximately 10 degrees of the dry bulb temperature, as large masses of steel heat very slowly. For safe protection the wet bulb temperature should never be permitted to reach a point closer than 5 degrees below the dry bulb temperature.

Other methods of preventing excess moisture or removing it from air in large warehouses are being developed, but they have as yet to prove their justification economically over the system described. Experience has shown that such simple and easily operated equipment as heating systems and wet and dry bulb thermometers will give adequate protection to iron and steel warehouses when intelligently used.

Abstracts OF THE PAPERS TO BE PRESENTED AT THE 34th ANNUAL CONVENTION AND IRON & STEEL EXPOSITION OF THE A. I. & S. E. APPEAR ON THE FOLLOWING 12 PAGES.

MODERN COKE OVEN DESIGN and PRACTICE

By FRED DENIG V. P.
Engineering & Construction Division
Koppers Company
Pittsburgh, Penna.

The purpose of the paper is to set forth some of the factors that should be considered in the design, construction and subsequent operation of a coke-oven plant. It is intended to summarize some of the principal items that should be considered by anyone interested in the construction of coke ovens.

The paper is divided into five main sections:

1. *Preliminary factors to be considered before beginning design*, wherein are discussed the application of the coke produced, the character and testing of the coals to be used, the relative desirability of the various by-product yields, the size and layout of the plant in relation to probable operating rates, and the labor situation.
2. *What damages coke ovens*, which takes up the various factors which tend to shorten oven life, such as the use of expanding coals, careless or irregular heating, bad design, or improper pressure conditions. The causes of oven failure are analyzed and the remedies provided in the newer designs are outlined.
3. *What is desired in a mordern oven*, under which are considered the requirements for satisfactory operation, including the delivery of a uniformly heated coke and the securing of as low a heat requirement for underfiring as is consistent with the temperature of the coke pushed and type of by-products preferred. A minimum loss of by-products by leakage into the heating system or vice-versa, is much to be desired, as is a plant that requires a minimum of labor, supervision and maintenance. Gas flow through the oven system is considered, as well as the use of blast furnace gas for underfiring the ovens.
4. *Classification and discussion of various oven systems.* The vertical flue regenerative oven is the standard design with all builders today, and may be divided into low-differential and high-differential types. Various designs of ovens are illustrated and analyzed. The features and details of the Becker oven is thoroughly discussed.
5. *Present trends in coke oven design.* The trend in oven dimensions is discussed and experience seems to indicate that there are definite practical and economic limits. The underjet method of feeding coke oven gas to the flue is considered, and presents some advantages. Some improvements in auxiliaries are mentioned, such as the self-sealing door and smokeless charging methods.

The paper summarizes a great number of the items to be considered in the design, operation, and construction of a coke plant, and contains much of interest to the operators and engineers of coke plants. Much of the information presented has not previously been available in the trade literature.

DESIGN and OPERATION of the MODERN BLAST FURNACE

J. C. BARRETT
Carnegie-Illinois Steel Corporation
Youngstown, Ohio

▲ THE history of the development of the American blast furnace is a story of continual change and progress, although the fundamental principles of the process have remained the same. The improvements made have all pointed towards increased production, improved quality, and decreased cost. Undoubtedly, this department in the steel industry ranks first regarding the number of men who have contributed to its development and the ultimate progress speaks well of the interchange of ideas among the various plants.

The greatest changes have occurred in the past fifty years, during which period furnace lines were modified over a wide range of designs. This development to the present lines and size of the modern furnace, with the size of the relative parts, will be discussed and compared in detail in this paper.

The auxiliary equipment of the blast furnace is also studied in detail. The size and duty of the furnace charging equipment, and the design of bell and top equipment are outlined, as well as the gas cleaning equipment. Hot blast stoves, perhaps the most important accessory of the blast furnace, are examined, and the questions of heating surface requirements and stove efficiency are gone into deeply. Special attention is directed to the need of substantial construction of the entire blast furnace and its auxiliaries, and the subject of refractory duty and selection is discussed.

The development of the actual furnace and equipment has been accompanied by similar progress in refinement of the process. This step brought a demand for materials of proper chemical and physical characteristics, with adequate control of these items. The investigation of the characteristics of coke and limestone and the development of their quality to meet the furnace requirements are outlined, as is the need for benefication of the ores.

Many improvements in the operating procedure of the modern blast furnace are also apparent. Investigations have been made showing the importance of the proper size of the charge and the distribution of stock in the top of the furnace. Furnace reactions have been extensively investigated. These items, together with observations and studies to determine the most economical operating procedure, are included in this paper. A method of blowing and filling the furnace is also given.

MODERN BLOOMING MILL DESIGN

By LORENZ IVERSEN
President
Mesta Machine Company
Pittsburgh, Penna.

▲ ASSUMING that the readers are familiar with the earlier types of blooming mill, this paper will deal with the modern design of blooming mill as it now exists.

The production of large ingots invariably gives reduced pouring and rolling costs. The drive for lower costs brought about a gradual increase in the size of blooming mills, as well as in their rates of production, and necessitated the strengthening of the entire mill structure and its drive to withstand the increased loads placed upon it.

Keen competition in the steel industry has brought about demands for higher quality and more rigid tolerances, and the various mill auxiliaries must be designed so that a satisfactory product may be turned out.

In the past decade, twenty-seven continuous wide strip mills have been built. The advent of these mills has imposed new requirements on the blooming mill, due to the demand for rectangular shapes and wide slabs, and further modifications are required in the design of the conventional blooming mill. Each year sees the installation of one or more new blooming mills to meet the changes in mill product requirements. The new modifications in mill design are discussed, and the advantages of the slabbing blooming mill over the conventional universal slabbing mill are pointed out.

The major parts of the mill and its auxiliary equipment are illustrated and described. Better knowledge of the conditions existing during the rolling operation has made possible much improvement in the design of the various component parts of a mill. Sizes of these parts are given, as well as speeds of operation and power consumption.

Typical illustrations of existing mills will be discussed and their various features pointed out, including the methods of handling crops and scale. Considerable attention has been given to such items, with a view to obtaining lower operating costs. The necessity for proper lubrication, because of the high operating speeds and heavy duty, is indicated, and the methods of meeting this requirement are outlined.

CONTINUOUS PICKLING WIDE STRIP STEEL WITH FLASH WELDING

By L. R. MILBURN
Electrical Engineer
Great Lakes Steel Corporation
Ecorse, Michigan

▲ THE present-day wide strip mill has created a demand for longer coils of strip steel, both for the cold mill department and the fabricating plants. Since most of the present-day mills must cross-roll the slab to get the wide strip, the coil is of necessity rather short. This paper will consider one of the methods for increasing the length of these coils, namely, by flash welding.

ARRANGEMENT AND DESCRIPTION OF EQUIPMENT

At the Great Lakes Steel Plant there are installed three 96″ wide continuous pickling lines. A Mesta-Thomson-Gibb 96″ flash welder and flash trimmer are provided in pickling lines Nos. 2 and 3. This discussion will cover the equipment located in line No. 3, as it was the first successfully operated wide strip 60 cycle flash welder with a Mesta plow type flash trimmer to be installed.

This line consists of the following apparatus: Coil conveyor, coil upender, Mesta Processor with coil opener, squaring device, upcut shear, flash welder, flash trimmer, stitcher, pinch roll, tables and guides.

All motions of the welder are electrically driven, except the pull back of the moveable die, which is electrically controlled, air operated. This welder will successfully weld strip of a maximum width of 96″ and a thickness of .125″. The minimum width handled so far on this machine was 32″ with gauges from .060″ to .115″. There are two water-cooled welding auto transformers located in the stationary base of the welder.

Due to the fact that flash welding was not contemplated when this pickling department was first projected, there was not sufficient space available for the conventional design of flash trimmer. Consequently, a radically different type of trimmer was developed, which satisfied space conditions and operated faster as well. This trimmer is of the plow type, and operated through a powerful pinch roll which provides a steady slow pull on the strip. A cutting compound is used, and trimmer knives may be used for as much as 100,000 tons of steel.

The primary object of the welder is to join two strips of steel so they may be pickled, cold rolled and processed without cutting out the joint. Stitching or

other methods producing bulky joints require that the joints be removed before cold rolling, which is satisfactory as long as hot mill coils are of sufficient weight and length for economical operations. Wider strip is limited in length due to the limitations imposed on slab length by cross-rolling in broadside mills.

The process of flash welding consists of heating by resistance, burning away the edges by flashing, then upsetting the metal while hot, thus forming a butt weld. Since all previous information available had been derived from 25 cycle current operation, some experimenting was required in order to set up a heat chart for 60 cycle current, which was found to be hotter for a given ampere welding load.

In the welding, the tail end of strip A, cropped to full width and squared, is advanced through the welder dies. The gauge head is lowered down to clean the excess flash from the die faces and also to function as a gauge against which to butt or align the strip ends. Strip B is now advanced from the processor to the upcut shear, where it is cropped, and cut at a predetermined bias. The amount of bias can be adjusted to any reasonable figure desired. One-quarter to five-sixteenths of an inch gives good results.

Strip B is then butted against the welder gauge head. The two strips must be aligned carefully, both sideways and as to distance between the two ends. The ends of the strip being in proper alignment, the operator sets the clamps to hold them in position until the weld has been completed. The setting of the clamps will automatically cause the gauge head motor to lift the gauge clear of the weld and lock it in this position until such time as the operator lowers it again. The operator can then start the cam motion, which will energize the welder contactor, starting the welding current to flow in the strip across the gap between the two strips. Due to the bias cutting, the gap between the strip ends is like a trapezoid. The current will soon start an arc at the narrow end of this gap and thence progress across the width of the strip, thus producing the required heat for welding. The arc will also burn away the edges of the strip ends.

The time of burning is determined by the speed of the cam movement. The amount of burning is dependent on the current or the setting selected on the multi-tap transformer. The burning continues until the edges touch. At this point the current is automatically cut off and the cam drive upsets the hot metal to form the weld. The dies remain in the closed position a fraction of a second to allow the weld to cool; then the clamps are released and the dies are opened by air. The weld is now complete and ready for trimming.

The weld is then moved to within a few inches from the point of the trimmer by means of pinch rolls, and the strip is lubricated. The trimmer knives are adjustable for clearance with the strip, and are usually set for a clearance of approximately .006″ between knife and strip.

The knives having been brought into position, the strip is now pulled slowly through the trimmer by the pinch roll; the knives plow off the bead and leave a weld that can be cold rolled. The trimmed weld will now gauge from .010″ to .016″ thicker than the parent strip. Soft welds can be obtained by close observation of the welding voltage, and are preferably held at not over 5 points Rockwell above that of the strip.

The power required to make a weld is much less than we anticipated. The kilowatt-hours per ton of steel pickled is approximately 3.5 kwh. The current required at 440 volts to make a weld on 93″ wide by .105″ thick strip is approximately 700 amperes with a "push-up" peak of 1500 amperes. This current decreases as strip of a lesser cross-sectional area is welded. For example on strip 30″ wide by .060″ thick: the welding current is approximately 200 amperes and the "push-up" peak is around 1100 amperes.

CONCLUSIONS

We have proved that 60 cycle power acts different when welding than 25 cycle power.

We have proved that special attention must be given to the design of aprons, guides, and processing equipment.

We have proved that standardized welding equipment is not satisfactory. The transformers and auxiliary equipment should be tailor made for each installation.

We have proved that a good voltage supply is of a vital necessity.

We have proved that welding in the continuous pickling line does not slow up operations.

EUROPEAN WELDING PRACTICE and AMERICAN TRENDS

By C. H. JENNINGS
Research Engineer
Westinghouse Electric & Manufacturing Co.
EAST PITTSBURGH, PA.

▲ WELDING in Europe has grown to be as important a tool in engineering as it has in the United States. To draw definite conclusions as to the state of advancement of the welding art in the different countries is a difficult problem. Certain industries are somewhat backward the same as they are in the United States. Other industries can match their work and welding processes with the best in the United States. The production of resistance welded tubing in England at the rate of 65 feet per minute and the use of welding manipulators in Holland to rotate a complete rail coach to facilitate all downhand welding are examples of outstanding progress.

European welding machines are of high quality and in many countries the use of a-c equipment surpasses the use of d-c equipment. Special attention has been directed to the development of low capacity machines for welding thin gauge metals with the result that very excellent a-c and rectifier type sets are being built for

this work. The d-c set is becoming more popular, especially in England, partly because of the development of alloy and non-ferrous welding, for which few or no satisfactory a-c welding electrodes are available.

Welding electrodes in Europe are primarily of the coated or shielded arc types although considerable bare and light dipped electrodes are still in use in Germany and France. Electrodes containing a center core of flux are still being used as well as bare type electrodes containing special ingredients which supposedly make it possible to deposit sound weld metal with good ductility.

Automatic welding machines are not common although both carbon arc and metallic arc types of machines are being manufactured. The more extensive use of welding in railway, ship, structural and pressure vessel work will undoubtedly create a rapid increase in automatic welding.

Spot and other types of resistance welding are not in as common use as they are in America. There is a great interest in this method of welding, however, particularly for automobile, aircraft and railway construction. Auto manufacturers are at the present time considering the installation of tube controlled equipment for the production of duraluminum bodies.

Gas welding, cutting and brazing are in common use and very high grade results are being obtained on all types of metals. Fabricated parts made from 1″ thick aluminum have been welded.

Although welding has made great advancements in Europe as well as in America it has still not reached its peak either from the standpoint of quality or application. In Europe many bridges have been welded while in America the welding of bridges has been confined mostly to bridge repairs. In the future there will be many welded bridges erected and the cost reduction obtained by the savings in steel required will make possible more and better bridges for the same expenditure of money.

The adoption of welding by the building code of such cities as London, New York and Pittsburgh will cause other cities to follow, while the development of overhead super-highways will be another important field.

Welding has been applied to ship construction for many years and the experience obtained is so encouraging that its application will continue to grow. Decreased maintenance and weight are two of the principal advantages of welding in ship construction although increased seaworthiness under severe conditions may also be added.

The application of welding on rolling stock for railways is growing every year thereby making possible improved appearance, increased safety and reduced dead loads.

Machinery, pressure vessels and miscellaneous engineering products have been constructed for many years by welding. There are still many applications in these fields, however, where welding is not used as extensively as it could be. The advantages of welding in reducing the construction cost, improving the product, and shortening the delivery dates have been proven many times. It is only a matter of time, therefore, until welding will find its place in every field because if the designer or fabricator does not specify it the purchaser will require it.

USE OF MIXED GASES FOR STEEL MILL OPERATIONS

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▲ THE Dominion of Canada has very large coal resources which are to be found towards the extreme East and West sections of the country. The central provinces, in which are centered a large part of the country's industries, find it more economical to import coal from the nearest points in the United States. Even then they find the cost of coal is appreciably higher than it is to those industrial plants located nearer to coal mines. This fact makes it essential to direct the use of imported fuel in such a manner that the highest possible efficiencies may be obtained and waste eliminated wherever possible.

Following improvements in blast furnace stoves, blowing equipment and the use of coke braize for steam generation, it became apparent that the Steel Company of Canada, Limited, at its Hamilton Works, would have a substantial surplus of blast furnace gas available for general plant use, and in 1929 the Company completed the installation of facilities for supplying blast furnace gas to the various melting and reheating furnaces throughout the plant. Provisions were made whereby this fuel could be mixed with coke oven gas.

The blast furnace gas, on leaving the furnaces, passes through dust catchers and water spray towers from which a large portion is returned to the stoves and boilers. The remaining volume is conducted to the Theisen disintegrator gas washers where the gas is further cleaned and delivered to a gas holder of one million foot capacity. From the holder the gas is led to consuming departments through 5000 feet of mains. The introduction of blast furnace gas as a plant fuel made it possible to shut down twenty-one gas producers.

The coke oven gas is boosted and delivered to the consuming points in mains,—for the most part underground.

By means of the two systems the gases can be mixed in any desired proportion, at any mixing station, to suit the local requirements.

The coke oven gas system is augmented further by a pipe line which delivers sufficient blast furnace gas to the suction side of the coke oven gas booster to enable 10 per cent by volume to be added. The introduction of blast furnace gas into the coke oven gas does not seem to require that the total Btu. represented by the coke oven gas shortage, be made up by an equivalent number of Btu. in blast furnace gas. This bears out the contention of others that the heating value of a gas can be manipulated within fairly substantial ranges without serious effects on operations.

Mixed gas has been used in several open hearth furnaces for over nine years. The gases are mixed in a mixing box and piped, cold, direct to the furnace ports. The proportion of each is adjusted by the heater as the heat progresses. On one furnace the roof temperature control reduces the coke oven gas and increases the blast furnace gas at such time as the roof temperature exceeds the allowable limit. High turbulence and high velocity in the port are necessary to direct the flame to the surface of the bath. The flames are practically non-luminous. This practice has worked well and has been very satisfactory as to fuel consumption. The safety, simplicity and low first cost of the application leave little to be desired. The brick consumption is low.

The furnaces reverse in about six seconds and no fuel is lost by reason of reversals. Automatic fuel-air ratio regulators, reversal by time or temperature difference and furnace pressure control are in use. The gross Btu. per gross ton of ingots for two furnaces over two years (1935–36) averaged 4,300,000. This included all gas that went into the furnaces for heating up as well as actual production. The average ratio of mixed gases was 1:1 or equivalent to 330 Btu. per cubic foot.

During 1937–38, with blast furnace gas reduced to about 10 per cent by volume, on continuous operation, with no heating-up gas and a greater percentage of hot metal, monthly Btu. per gross ton as low as 2,900,000 were consistently obtained on the new furnace started in June 1937.

The use of blast furnace gas and atomized bunker C fuel oil is at present being tried in open hearth furnaces.

Up to the present it has not been possible to operate the soaking pits in Hamilton on mixed gas as the whole supply of coke oven gas is needed to operate other mill furnaces. It has been evident on eight new pits, of a recent design and equipped with complete combustion and temperature control, that temperature distribution in the pit from top to bottom is much more uniform with blast furnace gas than with coke oven gas. The time may come when the temperature controller will regulate the mixture of gases rather than the volume of a high flame temperature gas up to a certain point and then control the volume only for the soaking period.

One pit was equipped for a trial on mixed gas. During a period when 10 per cent coke oven and 90 per cent blast furnace gas was used separately the Btu. per net ton of ingots was 988,000 with 87.7 per cent hot and black hot steel. During the test period with the same relative gas volumes burned together, 718,000 Btu. per net ton of ingots with 86.7 per cent hot and black hot steel was obtained. This test indicates that it is more economical to burn both gases together than it is to burn each separately, for the ratio of mix investigated.

The sheet mill is the largest consumer of mixed gas in the plant. Due to changes and increases in the demand for gas in this department it has been necessary to curtail mixed gas applications at other furnaces. One of the chief advantages of mixed gas appears in the reduction of concentration of sulphur compounds (where they are not removed from coke oven gas) which results in the preservation of alloy beams, chains and rolls composing furnace conveyor systems. Mixed gas in the ratio of 2:1 blast furnace to coke oven gas or 245 Btu. per cubic foot is used in continuous pack and pair furnaces, sheet and pair furnaces and blue annealing furnaces. The flames are practically non-luminous and appear quite blue when leaving the doors.

The normalizing furnaces uses a ratio of 1:1 of mixed gas or 330 Btu. per cubic foot.

The box anneal furnaces are fired with a mixed gas in the ratio of 10:1 blast furnace to coke oven gas or 130 Btu. per cubic foot. These furnaces were formerly fired with producer gas and have made a good showing on mixed gas with a reduction 1,300,000 Btu. per net ton.

One two zone billet heating furnace is fired with fuel oil in the upper burners and coke oven gas in the lower burners. During mill delays or intervals between turns straight blast furnace gas is used in the lower burners and the fuel turned off the upper burners. This allows temperatures to be held without danger of overheating or excessive scaling.

Future extensions for the use of mixed gas are indicated for firing coke ovens, soaking pits and billet heating furnaces.

Present indications are that in the future mixed gas will become a standard fuel in many plants. In the words of Mr. H. V. Flagg,—"Fortunate indeed are those plants which have coke plants and blast furnaces in balance with steel plants, and have had the vision and the means to install cleaning, mixing and distributing facilities so that practically the entire fuel supply comes into the coke plant as coal".

STANDARDIZATION of STEEL PLANT FUEL ACCOUNTING and TEST PROCEDURE for FUEL CONSUMPTION DETERMINATION

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▲ IT is out of the question to expect that the system of fuel accounting which has been worked out for one particular plant can be laid down as a pattern which will be applicable to all plants. The only justification for describing such a system lies in the hope that some ideas can be advanced which may be helpful to others in their own particular plants or may lead towards a standardization of reports which would make fuel data more truly comparable.

There is ample justification for a most exhaustive system of keeping fuel records. Direct fuel cost alone runs into such a considerable proportion of steel making cost that it should be kept under exact control. Steel plant managers would not tolerate any time-keeping

system that did not furnish exact data on labor cost. The amount of money involved in the fuel bill is so considerable as to demand a like standard of control. Further justification lies in the influence of fuel utilization on production and quality, which may involve as much or even more money than direct fuel cost. The first requisite for control of fuel utilization is dependable data on consumption. The fuel engineer's program, which looks toward improvement of weak spots and holding up good operations to standard, depends first of all on good fuel records. A system of fuel standards for the various operations can neither be set up nor maintained unless dependable records are available.

Our system of fuel accounting will be discussed as follows:

1. The manner of keeping records.—All fuel consumptions are posted daily, and balances are struck, so that in effect, distributions are made each day. The daily balance minimizes errors, makes daily cost control possible, and expedites the making of monthly distributions.
2. Basis on which fuel values are recorded.—Plants using only one fuel or having no interest in performance in other plants can use any convenient basis for reporting fuel. However, most plants use a variety of fuels, in which case it becomes advantageous to reduce all fuels to a common base. It is then only a step further to establish a standard set of values, reduced to one common denominator, which could be used by the industry in general. The use of million Btu. is recommended.
3. Control of fuel supplies.—Sufficient mechanism must be set up to ensure that we get the amount of fuel we are billed for, and that quality standards are maintained. Natural gas is accurately metered, and its gravity and heating value are checked daily. Fuel oil is checked by dome measurement and temperature in the car, and a viscosity test is run on each car. Coal receipts and consumptions are balanced by means of a carefully organized routine which provides a double check for each car of coal received. Coal analysis is checked from cumulative samples.
4. Metering set-up.—Adequate metering in a steel plant runs up to a surprising sum of money. The best policy to be followed is to have it understood that every fuel-using application should have a fuel meter as part of its auxiliary equipment. Gas and fuel oil are well-metered to the consuming departments, and coal is charged by methods set up from tests and experience. The meter set-up is discussed in detail.
5. Reports.—Reports are made daily to the manager's office showing fuels received, on hand, and used; to the cost clerk showing departmental consumption; and to interested parties, a summary of open hearth fuel performance. A weekly summary of fuel consumption, receipts and inventories is issued, as well as a running record of plant fuel performance. A monthly report is made which shows departmental performance compared to standards. This report is widely used as a measuring stick of fuel performance.
6. Standards.—For several years, we have been measuring our fuel performance against standard allowances, which provide a "bogey" as well as a comparative mark. The standards may include allowances for the various factors in operation which may affect fuel performance either favorably or unfavorably.

Standard allowances are established by calculating heat balances or by averaging previous performance, or by a compromise between both methods. They should be comprehensive, and subject to change in the light of changes in plant, in practice or improvements in performance attained.

For several years, the plants in our corporation have been comparing fuel performances each month. As the same set of values was used, direct comparisons could be made. Some startling improvements have been made, and the general level of performance has been raised in each plant.

It is entirely within the realms of possibility that some such set-up could be extended to include even a larger number of plants. Some difficulty might be encountered by any agency undertaking such a project, in securing the cooperation of enough plants to make the effort worthwhile, since the question usually arises whether sufficient benefits can be secured to balance the information put out. Our own experience furnished the answer to this question, for the plants making the poorest showing at the start soon improve their performance to the point where the leaders have to make improvement themselves to maintain their position.

ELECTROLYTIC PICKLING OF STRIP STEEL

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HISTORY OF APPLICATION

▲ THE electrolytic pickling of steel in either strip or sheet form has only been employed in comparatively recent years, although the electrolytic action is as old as electricity itself and has been evident in many ways throughout the entire application and use of electricity.

EXPERIMENTAL DEVELOPMENT

Approximately five years ago, Inland Steel began experimentation with the idea of evolving some feasible manner of employing electrolytic action in conjunction with, and to augment, the pickling of strip steel. The first experiments demonstrated conclusively that the removal of scale from steel could be expedited materially by the use of electrolytic action. Early experiments were made to determine the feasibility of using either

direct or alternating current. It was found that practically equally successful results could be obtained from either a-c or d-c current. Theoretically, the logical method would be to apply the current to the strip steel allowing this current to pass from the strip to electrodes suspended in the bath on either side of the strip steel. This would result in the scale being removed from both sides of the strip simultaneously. This method, however, was definitely not feasible, due to the difficulty of applying the current directly to the steel strip.

Next considered was the use of top and bottom electrodes, spaced about 18″ apart, and passing the strip between these electrodes imposing direct current on the top electrodes allowing it to pass through the strip to the bottom electrodes. While this is a workable arrangement, it results in cleaning only one side of the strip and the process would have to be repeated in reverse action in the second tank to accomplish cleaning on both sides of the strip.

It was finally decided a more practical method was to employ alternating current which would result in the current flowing in both directions between the electrodes passing through the strip which is located between the electrodes and thereby cleaning both sides of the strip at one time. Experience has brought out the desirable current densities, electrode design and material, and method of application, all of which are discussed in detail in this paper.

DESIGN AND INSTALLATION

The usual continuous pickling line consists of four acid bath tanks in series, each tank being approximately 60 ft. long. Electrolytic action is most pronounced after the sulphuric acid has penetrated the scale and has reached the surface of the steel. We decided to install electrolytic equipment in tanks Nos. 2 and 3 using tank No. 1 as a conditioning tank to allow the acid to penetrate the scale, delivering the steel to the two electrolytic tanks where the major part of the scale is removed. The fourth tank, which is immediately after the electrolytic tanks, is only used as a cleanup tank, as approximately 98 per cent of the scale is removed in the two electrolytic tanks. The paper further treats of the design and application of the electrolytic apparatus in detail.

OPERATION

Our electrolytic pickling equipment has been in operation since the early part of 1934. We have one pickling line so equipped. The installation is made on a line that is used almost exclusively for pickling coils for tin plate.

The coils pickled on our electrolytic pickling line range in length from 300 ft. to 360 ft. The time required to handle the coil at the feed end including shearing, welding and trimming is 1½ minutes average with a maximum time of 2 minutes. This provides for a strip speed through the pickle bath of at least 150 f.p.m. Before electrolytic pickling was installed on our line, the strip speed was from 70 f.p.m. to 90 f.p.m. After the electrolytic equipment was installed, the strip speed through the pickle bath is from 120 f.p.m. to 170 f.p.m. This wide range of pickling speeds is due to a number of factors such as coiling the steel hot, or somewhat cooled before coiling in the hot mill, coils stacked hot and allowed to cool before pickling or feeding into the pickler while steel is fairly hot, high phosphorus or high carbon steel coils, all pickling tanks full of fresh acid of 10 per cent H_2SO_4, or part or all of the tanks with low acid and high iron sulphate content. Any one of these factors has a direct effect on the speed of pickling and when a combination of tight scale, low phosphorus and low carbon steel, weak acid and high iron sulphate content in all tanks is encountered, the lowest pickling speed is the result.

An electrolytic installation will increase the speed of pickling on any pickling line regardless of the type of scale, the amount of scale breaking equipment used or the grade of steel being pickled. To realize the full advantage of this increase in speed and to actually secure an increase in tonnage, the pickling line, as a unit, must be able to operate in the time required for a coil to pass through the pickle bath. Under this condition an electrolytic installation will show a very good return on the investment. If this condition does not exist, the time saved by the use of electrolytic equipment will be offset by the delays due to preparing a new coil for feeding into the pickling line. In considering the installation of electrolytic equipment, the operation of the entire pickling line equipment must be thoroughly checked to determine if the handling and feeding in of the coil can be done in the time required for the coil to be pickled at the higher speed.

PERFORMANCE of SLABBING MILL AUXILIARY DRIVES with WARD-LEONARD CONTROL

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▲ IN February 1937*, one of the authors described before the A. I. & S. E. the Ward Leonard controlled auxiliaries of the Inland Steel Company's 46-in. x 104-in. slabbing mill. This installation, which includes the screwdowns, sideguards, live tables, and slab shear, is the first in which Ward Leonard control has been

*"Ward Leonard Control for Blooming and Slabbing Mill Auxiliaries" by W. B. Snyder, IRON AND STEEL ENGINEER, May 1937.

applied to all the major auxiliaries of a blooming or slabbing mill. When the original paper was presented, the drives had been in service only a few months, and specific operating data were not available.

Now, after about 20 months of service, complete tests have been made on these drives. It is the purpose of this paper to report the results of these tests, and to discuss the manner in which the apparatus has conformed to the original expectations.

Operating experience has indicated the desirability of some modification to the equipment as originally installed.

Tests have been conducted on the Ward Leonard drives by the use of a 6-element oscillograph with an additional timing vibrator. On each drive motor speed, armature current and voltage, generator self and separately excited field currents, and times were recorded. In addition, travel was recorded on the screwdowns, sideguards, and shear. As a check on the performance of the Ward Leonard drives, tests were also conducted on the magnetically controlled screwdowns of the 40-in. blooming mill in the same plant. These screwdowns are driven by two 85 hp. mill type motors with a modern series-parallel magnetic control.

A comparison of the tests on the screwdowns of the 46-in. mill and the 40-in. mill discloses several interesting features.

The maximum operating speeds of these two drives are quite comparable, which is to be expected. The authors make no claim that Ward Leonard control is inherently faster in operation than magnetic control. However, for equivalent operating speeds, Ward Leonard control will function with less stress on the driving motor and mechanical parts, and less wear on control parts. Or, for equivalent stress on the apparatus, higher operating speeds may be obtained with Ward Leonard control.

The tests have produced valuable data on the friction loads and operating cycles of heavy duty mill auxiliaries, and on the power required for slab shearing. They have also demonstrated that the Ward Leonard controlled auxiliaries have met the original expectations as to operating speed and flexibility with a comfortable reserve margin.

Operating experience has shown that the expected savings in maintenance costs have been realized. While much of this saving is undoubtedly due to the fact that the 46-in. mill is new and of up-to-date design, a portion is clearly attributable to the use of the Ward Leonard controlled auxiliaries. Accidents have occurred on the 46-in. mill, which would undoubtedly have resulted in mechanical breakage, were it not for the load limiting characteristics of the 3-field generator supplying the auxiliary motors. The savings here are intangible, but no less real.

As would be expected, there is an appreciable power saving with Ward Leonard control, due to the elimination of resistor losses. Although only the screwdowns, sideguards, live tables, and shear of the 46-in. mill are provided with Ward Leonard control, and the other auxiliaries are controlled magnetically, the auxiliary power costs per ton on this mill run consistently about 25 per cent lower than those on a similar mill with magnetically controlled auxiliaries throughout.

It is interesting to note that the Ward Leonard auxiliaries appeal strongly to the rollers, who appreciate the flexibility and responsiveness of this form of control. Their reactions are apparently similar to those of a driver who has just turned in his 1928 automobile for a new model.

It is the conclusion of the authors that the additional first cost of Ward Leonard controlled auxiliaries over magnetic auxiliaries for blooming and slabbing mills has been entirely justified by the operating results obtained on the 46-in. mill. If the job were to be done over, and if better means should not be available, we would do it again in the same way.

ACCELERATION of TANDEM COLD STRIP MILLS

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▲ WITH increasing delivery strip speed from tandem cold strip mills, the problem of acceleration in the shortest possible time is becoming more and more acute. Because the strip does not come on the gage until the mill is fairly well up to its final running speed, the longer is the acceleration time and the more is the off gage material rolled. On the other hand, as rapid acceleration is attempted to reduce this effect, serious tension variations may appear between stands because of associated motor inertias and armature circuit resistances, and because of the fact that all stands are effectively tied together through the strip, while potential is applied equally to the individual motor armature circuits from the bus.

This paper makes a study of the tension variations during accelerating and decelerating and derives mathematical formulae which relate the various factors. These formulae are given in the appendix of the paper.

Based on calculations and tests on several tandem cold strip mills, the authors sum up the results of their study by making some general recommendations for the selection of motors and control for future tandem cold strip mills. These conclusions are:

1. Select the motor rating for each stand to meet the expected rolling load, not permitting the desire for duplication of motors to be carried too far. Such an arrangement is inherently in better balance than where a 1500 hp. motor is called upon to carry a 500 hp. load.
2. Adjust, at least roughly, the total armature circuit resistance for each motor so that for the most popular schedule of the mill, the IR drop is about the same for each motor.

3. Select motors with as low WR^2 as possible, consistent with economy. Since the tandem mill is called upon to roll more than one schedule, and since balance of tension can be obtained only for one particular schedule, better overall operation will be obtained if the effects of WR^2 are minimized.
4. Provide some form of tension indicating device between stands. The limit of tension which a particular strip will stand without breakage can be avoided, only if the operators know what values of tension are being obtained. A tension indicating device will also warn the operators when the lower limit of tension is approached.
5. Some form of compounding, easily adjusted by the operators, appears to have some value in holding more nearly constant tension during acceleration. Such an arrangement is now in successful operation on several tandem mills.

LOW VOLTAGE RECTIFIERS FOR INDUSTRIAL REQUIREMENTS

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▲ DUE to the fact that electric power is generated and transmitted as alternating current, it is the practice to use this energy in alternating current motors wherever this type of apparatus satisfactorily meets the requirements. The demands in the steel industry on a large percentage of applications are such as to require direct current apparatus. With an increase in experience, it might be expected that the percentage of direct current apparatus would decrease, but just the opposite has taken place. This is due to the fact that greater use is being made of the advantages of electrical drive in working out the various improvements in the process of manufacture of steel.

With this trend towards the use of a large amount of direct current equipment in steel mills, it is only logical that some study should be given to the possibility of supplying direct current more economically than we have in the past. The conversion of power from alternating current to direct current in the steel industry is usually accomplished by the use of motor generator sets although a number of plants have used rotary converters.

For some time, manufacturers have been working on the development of the mercury arc rectifier for this type of service.

The development of the mercury arc rectifier involved two rather difficult problems, the first being that of maintaining a satisfactory vacuum and the other was to prevent what is known as arc-back. Modern technique in welding, development of present day insulating seals, and improvements in vacuum pumping equipment are responsible for solving the problem of maintaining a vacuum. The frequency of arc-backs was satisfactorily reduced by liberal spacing of the anodes from the cathode and rather elaborate use of shields and grids around the individual anodes.

Until recently, there was no means of synchronously starting the arc, so the arc was started by means of depressing a starting anode rod into the mercury cathode and withdrawing it, thereby "drawing" an arc. Once started, the arc had to be maintained continuously by an exciting current in some manner. Since it was necessary to maintain the cathode spot, and the ionized gas, in any event, it was possible to economize on starting and exciting equipment and on cathode material by mounting several anodes in one tank with one cathode and one starting and exciting system. Conventional rectifiers have regularly been built with six, twelve, or even more anodes per tank.

The presence of the cathode spot and the ionized gas in the tank greatly increases the tendency to arc back of an anode that is at the moment bearing back voltage. The shields and grids that were installed to overcome this tendency also obstruct the arc during the conducting period of the cycle and increased the arc-voltage drop in the rectifier to 20 to 30 volts while this voltage drop in a simple structure can be less than 10 volts.

The rectifier unit itself being a new piece of equipment, it is the logical place to work to obtain an improvement in efficiency. The tendency to arc-back is very much decreased if the gas is de-ionized and the cathode spot extinguished when current is not flowing, but to accomplish this, it is necessary to have some synchronous and instantaneous means of starting the arc at the beginning of each conducting period. The means that has been developed for accomplishing this consists of a crystal of high resistance material partially immersed in the mercury pool cathode. When current is passed from the crystal into the cathode of such an assembly, a cathode spot will be created from which any anode in the space may conduct current. Obviously, this is a process that can be carried out synchronously, and permits placing each anode in a separate tank with its own cathode, and in turn permits the complete extinguishing of the arc at the end of each conducting period. With this arrangement, the shielding of the anode may be reduced to a minimum and in the practical design utilizing this principle, the "Ignitron", the arc drop is reduced to the order of 15 to 18 volts instead of the 20 to 30 volts existing in the conventional rectifier.

Considering the high cost of interruptions, steel mill engineers must be conservative in trying out new equipment. For this reason, the natural place to install rectifiers would be on 250 volt auxiliary service rather than on individual mills where 600 volt is used. The efficiency of the old conventional type rectifier at 250 volts at light loads is better than that obtained from the motor generator set, while at full load and above the efficiency is about the same. With the Ignitron

type of rectifier, the reduction in arc-voltage drop raises its efficiency to a point where it is distinctly above the efficiency obtained from motor generator sets even at 250 volts and at full load and above. When its efficiency is compared to that of synchronous converters, the latter only exceeds the rectifier at loads of 75 per cent and better at 250 volts. On 600 volt circuits, the rectifier efficiency curves lie entirely above even that of a synchronous converter.

It is our feeling that steel mill engineers will become interested in this equipment for their service.

PICKLING of STRIP STEEL FROM THE METALLURGICAL POINT OF VIEW

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▲ IN hot working steel, a scale is formed, which it is usually necessary to remove either for further processing or for use. This scale is most frequently removed by pickling in an acid solution.

Investigation has shown that the scale consists of several layers of iron oxide, formed by the countercurrent diffusion of iron and oxygen at the surface of steel. The outer and middle layers consist principally of Fe_2O_3 and Fe_3O_4, respectively. The layer next to the base metal approximates FeO in composition. Since FeO decomposes into Fe and Fe_3O_4 below 1065°F., the nature of the heat treatment has been found to have a considerable bearing on the rate of pickling. Considering the free energies of the various reactions including iron, and iron oxides in the presence of acid, it will be seen that for standard state conditions the electromotive potential of the iron and Fe_3O_4 reaction in the presence of acid is comparatively large. It is evident that this reaction is the most probable one to take place in pickling. By controlling the conditions of scale formation, it is possible to minimize the pickling required.

Pickling is ordinarily accomplished by immersing the steel part in an acid solution. Though both hydrochloric and sulfuric acids are satisfactory, the latter is most frequently used for economic reasons. The acid concentration is customarily in the range of three to fifteen precent H_2SO_4, while the iron or copper as content of the bath will be from a very low value to twenty to twenty-five per cent $FeSO_4$.

The commonly accepted mechanism for pickling is that the acid penetrates the pores of the scale, reacts with the base metal, and generates hydrogen lifting the scale off of the steel. From the above theory, it appears that the acid probably dissolves at least a part of the innermost layer of scale before the scale is lifted.

Inhibitors are additive agents for the pickling bath which prevent the action of the acid on the base metal after the scale is removed. Most inhibitors are organic in nature, and are adsorbed to cathodic areas of the base metal. Attention should be called to the fact that the use of inhibitors on steel which is to be galvanized or porcelain enamelled, will sometime give trouble. For specific purposes and in limited concentrations, inhibitors may prove satisfactory for these products. They should be used only after tests have indicated that difficulty will not be encountered.

Blisters are produced when atomic hydrogen diffuses into the metal under pressure. This pressure is the result of surface tension on small bubbles. The atomic gas diffusing into the steel, meets a discontinuity in the base metal, such as an inclusion, forms molecular hydrogen, and raises a blister. Since inhibitors decrease the evolution of hydrogen, they also decrease the formation of blisters.

When the scale is cracked on steel which is to be pickled, the steel is usually etched along these cracks Inhibitors will not eliminate this type of etching action.

The batch pickling of steel has been carried on for many years and the equipment for this process is quite familiar. Also, the pickling of narrow strip is not new, and continuous picklers have been used for some time. The demands for wide hot roll, pickled, and cold roll strip, is of comparatively recent origin. The engineering development of equipment for pickling strip has progressed to a remarkable degree in recent years. The newer strip and rotary picklers have many advantages over the earlier types.

REQUIREMENTS of 400 VOLT A. C. MOTOR CONTROLS

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Jones & Laughlin Steel Corp.
PITTSBURGH, PA.

▲ THE narrowing margin of profit in the steel industry makes imperative an economical choice of electrical equipment, capable of meeting the heavy demands of steel production, yet versatile enough to be salvaged and re-used for another application. In the field of 440 volt equipment, this point has been almost entirely overlooked, in spite of the desirability of the use of 440 volt systems. It appears that the line of demarcation between the use of high and low voltage motors should lie between 400 and 600 kw. capacity.

It is recommended that 440 volt service be broken up into lower concentrations of power, not exceeding 4000–6000 kva. capacity in the transformer banks.

The question of short circuit currents to be expected from a 440 volt system must consider arc voltage drop, current transformer reactance, and other factors tending to limit the current, which are ignored with the higher voltages, but are really the limiting factors with 440 volts, where the possible short circuit current approaches 40,000 amperes. This figure of 40,000 amperes drops rapidly with increasing distance from the power source.

The larger contactors and breakers have demonstrated their ability to withstand this severe service, but trouble has been experienced with starters and breakers from 100 hp. down. A study as to what type of equipment is best suited to this exacting service was made. Existing equipment is subject to some criticism, being, in the main, over-rated as to rupturing capacity. A tabulation of available equipment for various applications has been compiled.

New developments in steel mill equipment open up further desirable fields for 440 volt ac. systems. The increasing use of electro-cleaners, electro-plating, electro-inhibitors, etc., calls for the application of numerous small individual motor generator sets. The extensive application of Ward-Leonard control systems to shearing and cleaning lines, wire-drawing blocks, roll tables, etc., presents another field for small motor-generator sets. These applications are well satisfied through a 440 volt a-c. system.

The safety hazards of 440 volt power are not materially greater than those of 220 volt power. Certain safety recommendations are set forth.

The use of 440 volt motors instead of higher voltages is desirable where the current does not exceed 1200–1500 amperes. Current in excess of these volumes cause magnetic difficulties, making it necessary to go to higher voltages.

Devices with interrupting capacity of less than 20,000 amperes should not be depended upon as fault interrupters on a 440 volt system. Large frame air circuit breakers with an interrupting capacity of 60,000 amperes should be used on main 440 volt busses as feeders. Feeder circuit breakers should be made automatic reclosing. Dash-pot series overload relays on these breakers should be discarded, and induction type three phase inverse time relays should be substituted. High interrupting contactors can be used safely on a feeder circuit where they are connected at any point beyond several hundred feet from the main bus.

For smaller motors the installation should be either 440/220 volt transformers to step down the voltage, or a group of motors may be placed back of an interrupter of 20,000 amperes or better with comparative safety. Considerable work can be done in this field by manufacturers to make available contactors of adequate short time ratings and sufficient strength to hold them together and keep them from welding during the interval required for a breaker to clear.

For 440 volt equipment, the following recommendations are made:

1. Greater spacings between phases.
2. Slate busses instead of compound.
3. Changing of present day terminal blocks.
4. Enclosing of busses and main connections.
5. Isolating switches for each main circuit.
6. Adequate push buttons and master switches for 440 volts, or an improved supply method of 220/110 volts for control.
7. A thermal overload relay for starters using the induction principle rather than the bi-metal strip.

It was possible to offer but few solutions in this paper. Suggestions have been made as to the application of present apparatus. It is suggested that the major manufacturers give these problems further consideration and present their recommendations either at a future meeting or to an appointed committee, who in turn will make proper standardization as was done with d-c. mill type motors.

FINISHING EQUIPMENT FOR WIDE STRIP MILLS

By JOHN L. YOUNG
Manager, Machinery Sales
United Engineering & Foundry Company
PITTSBURGH, PENNA.

▲ EIGHTEEN months ago the author read a paper before the Association of Iron & Steel Engineers titled "Mechanical Developments of Modern Cold Rolled Strip Mills" and at that time referred to some new developments for strip mills including strip welders, belt wrappers, electrolytic cleaning lines, and rotary picklers.

The 98" hot and cold strip mill that was under construction at that time and has since been completed, was also briefly outlined.

This paper will further illustrate and describe by movies and slides these units and their further development as well as other finishing equipment for wide strip mills.

Since that time a number of strip welders have been placed in operation. These are both gas and electric flash type welders. Both have their fields, with gas apparently making the best commercial weld, but the flash weld allows a time cycle that is one-half to one-third of the gas weld cycle making it possible to be installed in pickling lines and as part of the newly developed and patented continuous cold rolling reduction mill scheme.

The automatic head gas welder requires a complete shearing and welding cycle of from three to six minutes. The electric flash weld has a full cycle of from 1¼ to 3 minutes. The relative difference in the two welds will be discussed.

The development of the continuous rolling cold reduction mill, while not new on paper, is new from the practicable standpoint, for the time cycle and effi-

ciency of the strip welder is the key to the whole arrangement. A further description of this high production unit will be given.

Two belt wrappers are now in regular production on tension reels of wide cold reduction strip mills and two more are now being built. One of these, a unit on the 77″ 3-stand tandem cold reduction mill of the Otis Steel Company in Cleveland, handles strip up to 16 gauge and up to 72″ wide on a 30″ diameter tension reel.

The first wide electrolytic cleaning line has been installed but the scarcity of business during the past few months has prevented production experience. This line is 84″ wide. It will be illustrated and described. Cleaner speeds and designs will also be covered.

In the afternoon following the presentation of this paper, there will be an inspection trip of the Association of Iron & Steel Engineers to the 98″ hot and cold strip mill of the Corrigan-McKinney Division of Republic Steel Corporation in Cleveland. A brief description will be given of the newer features of this mill including the hot mill, the feeding uncoiler of the 3-stand 98″ tandem cold mill, the shearing lines, levellers, the hot flying shear and numerous other points. This hot flying shear is new both in its electrical and mechanical details.

WELDING AS USED IN INDUSTRIAL PLANTS

By DR. GILBERT DOAN
Lehigh University
BETHLEHEM, PENNSYLVANIA

▲ THE developments in welding which were reported as new in the author's paper delivered before the Association of Iron and Steel Engineers in Pittsburgh in 1932 are now so widely used that they need not be mentioned except as a background.

The shielded arc made possible a speedy weld, with plenty of ductility, but left serious embrittlement beneath the weld, as well as causing distortion of the object welded. The newly developed smothered arc process, however, has raised welding speed to forty times that of the shielded arc, and diminishes both embrittlement and distortion without any sacrifice of quality. Results obtained with this new process will be shown by illustrations and samples, and the limitations of the process will be pointed out.

Continuous rail welding, which has proven a desirable economic item, is described and illustrated, as are continuous seam spot welding and shot welding.

The paper also discusses the flame hardening and flame softening processes. Copper-hydrogen brazing is mentioned. Experiments in welding with pure iron, in progress for the past eight years at Lehigh University, are also briefly described.

AMERICAN and EUROPEAN LUBRICATION PRACTICE for STEEL MILLS

By R. M. GORDON
Gordon Lubricators Division
Blaw-Knox Company
PITTSBURGH, PENNSYLVANIA

▲ THIS paper deals particularly with the selection and application of greases in the steel plants in this country, and in England and Wales. Reference is also made to general lubricating problems requiring both mineral and compounded oils for their solution, as well as to the various methods of application.

The application of an interesting new soluble oil which has been used successfully in place of a high demulsibility mineral oil is discussed, and the suggestion offered that similar application might be made on oil flood lubricated bearings of the oil-flooded type.

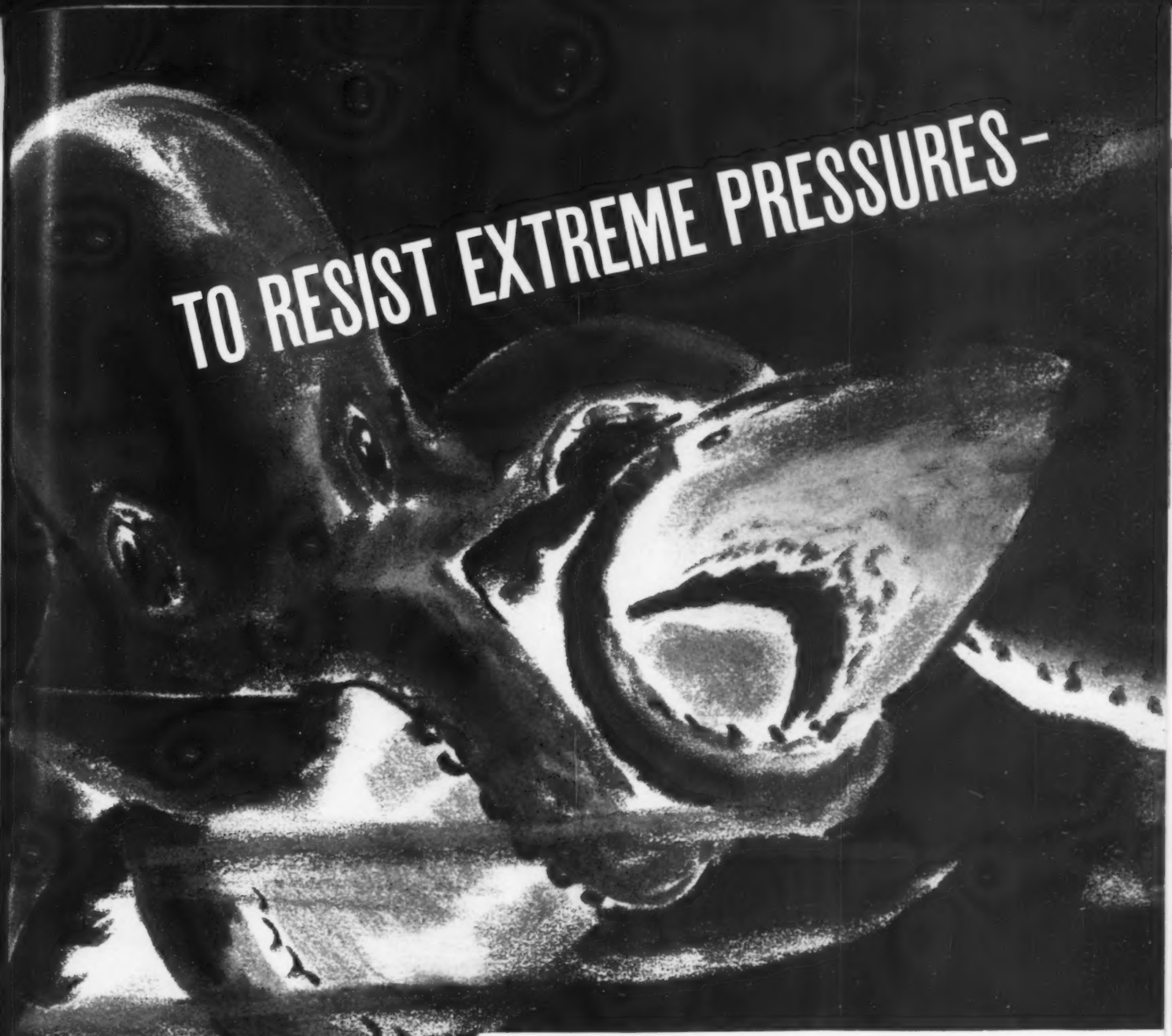
The advantages of the proper application of lubricating systems are briefly presented with typical resulting savings in power cost, bearing cost, and lubricant cost. The disadvantages of misapplication and the imperative necessity of eliminating them are presented along with suggestions for reducing the cost and increasing the efficiency of lubricating system installations.

OIL BURNING - ITS CONTROL

By A. J. FISHER
Fuel Engineer
Bethlehem Steel Company
SPARROWS POINT, MARYLAND

▲ THIS paper considers the use of fuel oil, particularly as applied in the steel plant. A short history of the introduction and use of oil in the steel industry traces the rapid strides of its application, and the responsibilities of the fuel engineer in the design, installation and operation of oil-fired furnaces are outlined.

Devices for regulation and control in the use of fuel oil are discussed. The various types and designs of oil burners are examined, and their particular applications considered. Oil conditioning systems, which perform the highly important work of properly maintaining oil temperature or viscosity, are analyzed. Particular attention is given to combustion control systems for fuel oil. Heating rates of oil-fired furnaces are discussed, and complete combustion data for fuel oil are presented. The paper is well illustrated and should serve as a valuable reference to all those interested in oil burning.



LUBRICANTS FOR THE STEEL INDUSTRY SINCE 1885

STEEL PICKS PENOLA

The *hard* way . . . that is how Penola has won its position with the steel industry. Penola makes and sells more steel mill lubricants than any other maker in the world because Penola proved the quality of its lubricants by handling steel's toughest jobs. Today, where the going is toughest—on the roll neck bearings of 4-high mills—Penola handles the job for over 85% of the industry.

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PENOLA INC., PITTSBURGH, PA.

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YOUNGSTOWN SHEET AND TUBE EXPANDS FACILITIES FOR COLD REDUCED TINPLATE

▲ The Youngstown Sheet and Tube Company has completed a two-year program of expansion of manufacturing facilities for cold reduced tin plate at its Indiana Harbor plant. Added equipment includes a new four-high reversing cold mill, an electrolytic cleaning line, a single stand and a two stand skin pass mill, as well as trimming and shearing lines and other finishing equipment.

The new four-high reversing cold mill, which has been in operation about a year and a half, is practically a duplicate of a previously installed mill. It is a four-high, 18″ and 49″ x 42″ stand, with roller bearings on both work and back-up rolls. Coils ready for cold rolling are placed in a coil box, from where they pass through a nine roll leveller to the entry side of the mill. From the delivery side of the mill the strip is entered into a solid type reel drum, and rolling proceeds with front tension from the reel and back tension from the leveller. Another reel is provided on the entry side of the mill, so that the mill may be reversed back and forth to obtain the necessary number of passes.

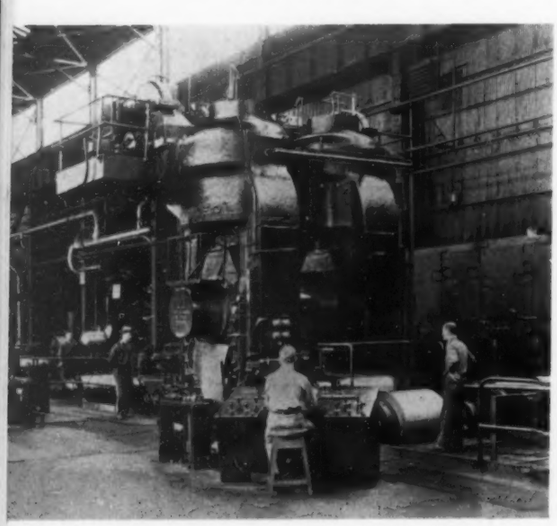
An interesting feature of this mill is the turntable provided for handling the loaded and empty reel drums. The loaded drum is released and discharged from the reel by air cylinders, and proceeds down a level track to the turntable, on the other side of which is an empty drum. Rotation of the turntable through 180 degrees puts the empty drum toward the mill and the loaded drum ready for removal.

The skin pass mills are also 18″ and 49″ x 42″ stands, similar to the reversing mill. They are of heavy rigid construction, designed to give rolling pressures up to 3,000,000 lb. each, in order to obtain the higher Rockwells demanded in tin plate today. At the entry end of the tandem mill is a cone type uncoiler with a drag generator mounted on each cone shaft. From the uncoiler the strip passes around a set of bridle tension rolls before entering the mill. Back tension is supplied to these rolls by a drag generator operating through a set of pinions. Automatic control of tension on the strip is effected through a tensiometer mounted between the two stands. Each stand is driven by a 350 hp. variable speed motor, direct connected to the pinion stands without any gear reduction. The forged and hardened steel work rolls are internally water cooled and mounted in roller bearings. Back-up rolls are of cast steel and run in oil-flooded bearings.

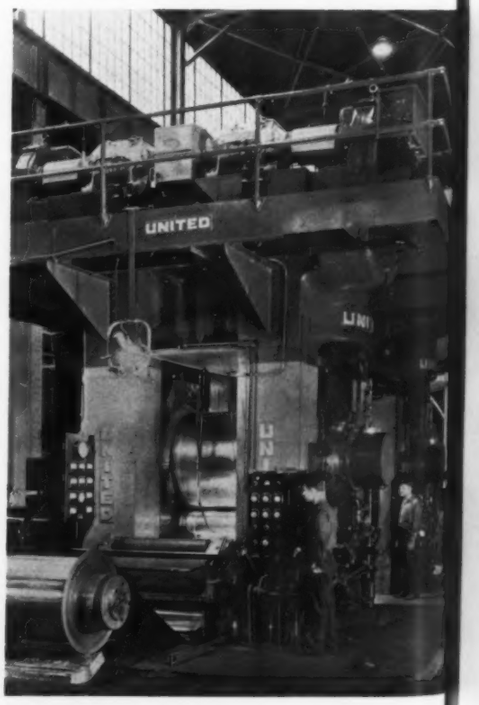
Leaving the mill, the strip passes through a set of rolls which supply front tension, and on to a reel with a collapsible type drum. A maximum delivery speed of 1600 ft. per minute may be attained in this mill.

The new cleaning line, of 38″ nominal size, operates at speeds up to

This United 4-high reversing cold mill, an 18″ and 49″ x 42″ stand, has been in operation about a year and a half.



The new tandem skin pass mill, also designed and built by United, may attain a maximum delivery speed of 1600 ft. per minute.



more than 1000 ft. per minute. It uses the electrolytic caustic method of cleaning. This unit, together with a previously built unit, handles some product rolled at the company's Campbell Works in addition to the capacity from the two reversing mills n this plant.

FORK TRUCK HANDLES SIX-TON COILS

▲ Down a ramp from the cleaner and onto the waiting forks of a giant Yale Upending Truck rolls a coil of strip weighing six tons.

Easily and smoothly in response to the will of its operator, the fork truck tilts, elevates and revolves this 12,000 pound coil of continuous strip from a horizontal position to vertical, carries it to scales for weighing and then delivers it to cars bound for the annealing oven.

This operation is a close-up of a link in the processing chain at one of the great steel mills in the United States—a mill having an ultimate capacity of 200,000 gross tons of tin plate per year.

In a plant of such proportions, covering as it does 22 acres, a number of synchronous operations are necessary. Not only is the upending electric truck a mobile and essential tool in speeding the material entoute through the mill, but it is so spectacular in its role of "mechanical magician" that it fits perfectly into the huge performances of a great steel manufacturing plant.

Tin-plating, which is said to have begun in Bohemia around 1240 A.D. and to have been furthered in 1728 by the construction of the first sheet rolling mill, has matured in our mechanical age until a modern tin plate plant includes such operations as the following:

Continuous pickling to remove all scale from the strip, cold mill reduction, or cold reducing the strip furnished by a hot mill; electrolytic cleaning of the oil film remaining on the strip after it leaves the cold mill; annealing—to soften the steel and to remove rolling strains; temper passing and surface conditioning after the coils are removed from the annealing ovens; white pickling or preparing the sheets, cut to size, for tinning and finally the tinning of the finished sheets.

Coils from the electrolytic cleaner are received by the truck, upended for weighing, and transported for further processing.

Four upending trucks are in service between the electrolytic cleaner and the annealing ovens. These machines have a rating of 14,000 lbs. or 260,000 inch-pounds and are 92″ in overall height. Each truck is equipped with five adjustable 40″ long forks, three on the bottom and two on the side for handling 54″ diameter rolls. In this installation they replace the combination of permanent upender and ram truck by elevating, tilting, upending and transporting with this one piece of equipment.

The trucks have a 76″ wheelbase and have embodied in them the exclusive Yale articulating feature. In this design the frame is split transversely and the halves joined by a large shaft or bolt. The front and rear sections of the truck oscillate about this shaft, a motion which is controlled within proper limits and in this way the truck is provided with a caterpillar type of motion.

The unique advantage of this construction is evident when the truck operates over any surface irregularities. Four wheels are always on the ground. The caterpillar motion which permits this also removes torsional strains which would be induced were the frame solid.

Another design widely advertised today and included as standard equipment on this and on all Yale trucks is the new Cam-o-tactor. This is a mechanically operated contactor controller for the drive motor. Because it is mechanically operated it provides the advantage of contactors in the interrupting of high capacity currents with the safety of positive action. This controller also includes the permanent Alnico blowout magnet for deflecting the arcs from the contacts, reducing burning to a minimum.

Upending is accomplished through the medium of a large bull gear and pinion, turning the carriage and coil through 90 degrees. The trucks are motivated by sixty volt power units or gas-electric generators.

Another important adjunct to the efficient operation of these giant trucks is the Yale electric steer; a turn of the lever closes a follow switch which immediately opens requiring the operator to keep following along with the steering handle in order to have the truck turn in a complete circle.

With this arrangement the position of the steering wheels are indicated at any instant by the position of the lever without necessitating the operator's peering over the side. Also, with the follow idea, microscopic control is possible, giving the operator constant and instant response to his wishes.

Team work in the movement of material through the tin mill is but one of the many uses for the electric truck in industry.

The foregoing descriptive matter pertaining to the Yale Fork truck was prepared by J. J. Murray, industrial power truck sales, Yale & Towne Mfg. Co.

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MODERN GALVANIZING UNIT INSTALLATION GIVES HIGH PRODUCTION EFFICIENCY

▲ Illustrative of developments in galvanizing equipment, one of the latest installations at a continuous strip mill opened last year in the North Atlantic States consists of the following straight-line units:

(1) Galvanizing machines and drive; (2) Magnet rolls and first section of fence conveyor; (3) Second section of fence conveyor and chain guide; (4) Heavy roller leveller; (5) Pinch rolls and washer and cooling tank; (6) Hot air dryer and conveyor; (7) Light roller leveller; (8) Inspection table.

This equipment was built by The Aetna-Standard Engineering Company of Youngstown, Ohio, which has centered its improvement efforts upon synchronization of the drive for the rolls. A new line embodying additional refinements, particularly with respect to accessibility of the various units, is now under construction for a large central states steel plant.

Preceding delivery to the galvanizing machine, the sheets are placed in a controlled oscillation pickler, then taken to a holding tank which prevents oxidation. Packs 2 inches to 4 inches in thickness are removed by an overhead crane as needed from the holding tank and placed upon the feed table, where the sheets are fed one at a time to the first pair of rollers in the acid dip feeder. The solution in the feed tank is commercial muriatic acid, full strength.

Next the sheets pass through a pair of rubber rollers where surplus acid is squeezed off. These rollers are approximately 8 inches in diameter and they feed the sheets into the flux rollers, which in turn feed them through the flux in the flux box to the zinc bath and by means of guides to the bottom rollers. The sheets are carried by the bottom rollers through the molten spelter to the exit rollers, their centers being fixed at the level of the molten bath.

The rollers are all driven by a single motor drive, arranged so that the bottom rollers are driven direct from the variable speed power source, with a stepless variable speed transmission placed between the bottom roller drive and the flux roller drive, and with a second stepless variable speed transmission placed between the bottom roller drive and the exit roller drive.

The variable speed transmission between the bottom roller drive and the flux roller drive allows the operator to synchronize the flux rollers to the bottom rollers. The second variable speed transmission, between the bottom roller and the exit roller drive, also synchronizes the speeds of these rollers, thus tending to eliminate guide scratches and buckles.

Attaining the same surface speed for all rollers had long been a problem, since the flux rollers work in air, the bottom rollers in molten zinc, and the exit rollers partially immersed. This results in varying degrees of wear and alloy build up. The exit rollers require more frequent changing than the others.

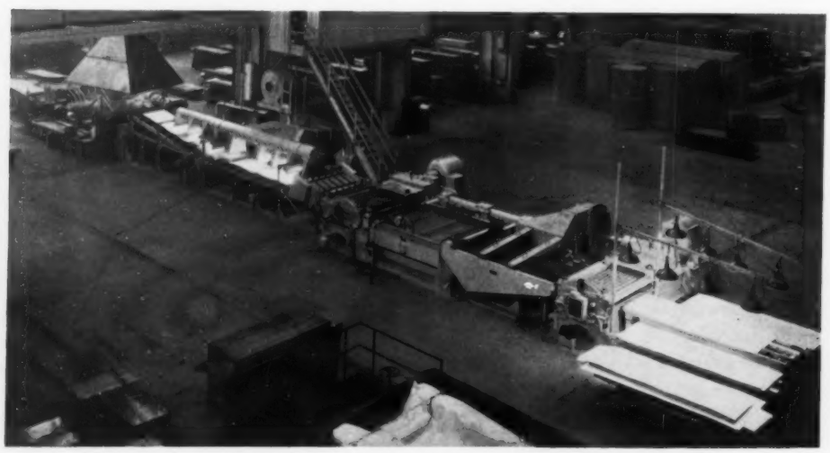
Objects of the drive arrangement of the Aetna-Standard equipment are to enable the remachining of rollers without holding to fixed diameters, to eliminate buckles and scratches of the sheet and to maintain slight tension on light gauge material while in the bath.

The drives are totally enclosed and all bearings are of the anti-friction type. Usually the motor is of 15 H.P. with a 4 to one speed range, which with change gears in the drive allows a total speed variation from 10 to 160 f.p.m. The drive is arranged so that the entire unit slides back on the hob plates, thus disengaging all drive shafts from the rollers and allowing the galvanizing rig to be removed from the kettle.

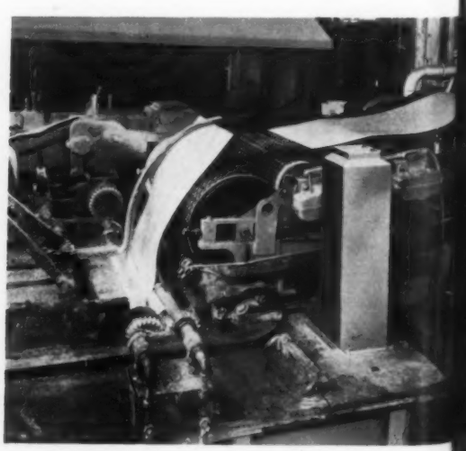
For lighter gauge material, the kettle is 106 inches long with one pair of bottom rollers. A larger size, 136 inches long inside the kettle with two pairs of bottom rollers, will handle all gauges, although its advantage is in the heavier gauges.

The larger kettle, 136 inches long, 90 to 96 inches wide and 72 inches deep, holding approximately 160,000 lb. of spelter, is heated by a pot setting of insulated construction in which the combustion chamber is at the entering end of the kettle with arrangements to control the hot gases around the sides and the rear of the kettle. The metal is maintained at approximately 810 deg. F. Gases are removed through a combustion

General view of complete straight-line galvanizing unit.



Conveyors made of wire fence passing over electro-magnetic rollers carry sheets out of the galvanizing machine.



stack. The flow of gases is controlled by dampers. The kettle is insulated to a height of 18 inches from the bottom to allow for dross settlement, the dross remaining in the bottom due to the fact that there is no heat to raise it.

Fuel can be heavy crude oil, light fuel oil, natural gas or coke oven gas.

The sheets upon leaving the exit rollers are taken away by a conveyor made of wire fence. Two electromagnetic rollers 12" diameter are placed beneath the fence belting in such a position as to carry the sheets away from the exit rollers and to insure a uniform contact with the belt, thereby producing a uniform spangling of the zinc coating. The fence conveyor is in two sections in tandem; the first with a coarse mesh wire belt for spangle control; the second of a fine mesh for durability.

While the sheets are traveling down the conveyors, cold air is blown on them from both top and bottom from a 30 H.P. blower, having a capacity of 20,000 Cu. ft. of air per minute at about 5½ inch static pressure. The sheets are cooled down to approximately 300 deg. F.

On the 136 inch lines a heavy roller leveller is provided at the end of the second fenced conveyor, then the sheets pass through a pair of rubber covered pinch rollers and is fed through a water washing and cooling tank.

The water tank has a controlled temperature of approximately 150 deg. F. The method of controlling is by adding cold water as the temperature gains or by heating with steam if the temperature drops. This temperature can be controlled within 5 degrees.

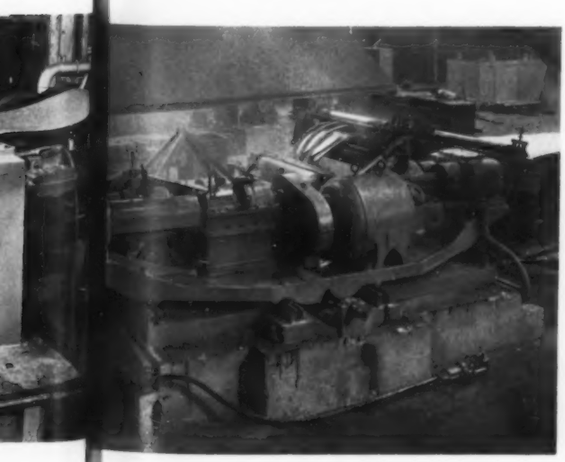
Then the sheets pass on to the drying table by means of a fiber disk conveyor where they are exposed to hot air blasts, top and bottom. Next they pass through the smaller diameter roller leveller for final flatness from which they are delivered to the inspection table.

Each roller leveller has its independent drive and the washer and dryer conveyors are driven from the leveller drives.

On the 106 inch line the procedure is the same, except that the heavy roller leveller is omitted.

An output of 70,000 to 90,000 lb. per 8 hour turn can be expected on average sizes and gauges of sheets.

Roll speeds in the galvanizing machine are synchronized through variable speed transmissions.



Adding water to batteries becomes a simple and easy task with new cell filter.

NEW DEVICE AIDS BATTERY MAINTENANCE

▲ A new and improved Exide water cell filler, which makes the adding of water to Exide motive power batteries a simple and easy task, is announced by The Electric Storage Battery Company, Philadelphia.

The new Exide cell filler eliminates the guess-work from the job and, as pointed out, guesswork frequently results in overfilling or underfilling the cells. This, in turn, not only results in a sloppy battery, but in poor performance.

The new and improved cell filler, designated as Type LV, simplifies and speeds up the operation of adding water at the same time permitting the job to be done neatly and ensures filling to the proper level.

The filler, Type LV, consists of a moulded semi-hard rubber nozzle with a set of electric contacts and a filler pipe moulded in. A handle is mounted on the filler pipe. There is a hand-operated valve behind the handle, to which is connected the rubber hose leading to the source of water supply. The electric wires which pass from the nozzle contacts into the handle and the signaling device are covered with a moulded, semi-hard rubber tube for protection.

The valve can be rotated to bring the valve handle in the most convenient position for any individual operator by loosening the union between the valve and the filler pipe. The nozzle is of the proper size for use in motive power batteries generally, and other batteries whose covers have a filling hole of the same dimensions as the Type MV cover.

The cell filler takes its electric current for the signaling device from the battery that is being filled. It is what is known as a "single-circuit" (single-conductor) filler. The signaling device can be either a lamp or a buzzer mounted on the handle.

The filler is so designed, however, that it can also be supplied as a "two-circuit" (double-conductor) filler, using a separate dry battery for the current supply to the signaling device. For this type, a separate box is required for the dry cells and bell, although a lamp or buzzer can be mounted on the handle, if desired.

The cell filler is made in two standard lengths, the distance between the center of the handle and the center of the nozzle on the short filler (Type LV-14), being 14 inches; and on the long filler (Type LV-21), 21 inches. The short filler is more convenient where there is ample headroom over the top of the bettery, while the long filler is more satisfactory where the headroom is low and where it is a considerable distance to the cells in the rear of the battery compartment.

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JONES & LAUGHLIN'S RESEARCH LABORATORY INCLUDES MINIATURE STEEL PLANT

▲ As a means of improving correlation between research and practice, the Jones and Laughlin Steel Corporation has built a new research and development laboratory containing many unique features. In the past, it has been the general practice to conduct research by a laboratory procedure, which resulted in advancements being made in research faster than they could be tested and applied in the mills. The new research and development department overcomes this handicap by combining the research laboratory with an assembly of development equipment in which steel making practices, under complete technical control, can be studied on a small scale resembling mill conditions. Steel making facilities of the pilot plant include an open hearth furnace, electric furnaces, heating furnaces and rolling mills.

The open hearth furnace has a capacity of 1500 pounds, and is of an original design developed by the staff. It is a recuperative furnace, side-fired with natural gas through three special burners which produce a flame sufficiently short for the small furnace. Air for combustion is pulled, by a high-temperature fan, through a recuperator consisting of carborundum tubes located in the furnace stack, where a preheat temperature of 1100-1200 degrees F. may be obtained. The hot air then passes to the burners. A single charging door serves the furnace. Instruments applied to this furnace include a roof temperature recorder, air temperature recorder, furnace pressure recorder, and gas and air flow meters. The new type of construction in this experimental furnace may be applicable to large furnaces used in actual production.

In addition to the open hearth furnace, steel making facilities include a 375 pound two-electrode single phase arc furnace used for experiments on slags and steel making, and a 30 pound electric induction furnace. An 18″ cupola is available to supply molten iron for a small Bessemer converter which will be installed later. Metal and slag analyses from the pilot plant are made in a chemical laboratory nearby. The equipment provides a wide range of flexibility in experimental work.

The ingots cast in the pilot plant weigh from 185 to 900 pounds, and may be rolled in the pilot mills, or in special cases, in the production mills of the steel plant.

Two rolling mills are used in the laboratory. The larger mill, a single three-high 10″ stand, can reduce a 4″ square ingot down to a 1″ square, while the two-high 6″ mill can roll 1¼″ square billets down to ½″ square. A 500 pound steam hammer is also available for the reduction of the test ingots.

Heating furnace equipment includes a 24″ diameter x 60″ high soaking pit of original design, a 3′ x 6′ gas-fired heating furnace, and a 4″ x 4″ x 12″ electric heat-treating furnace.

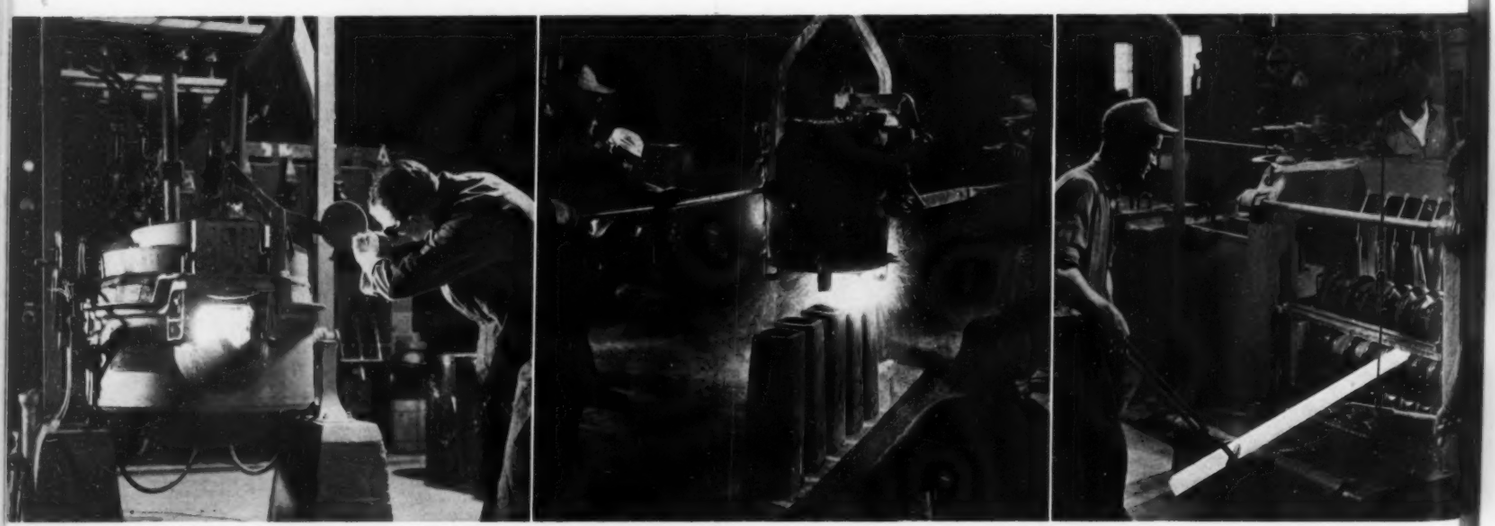
All of this equipment comprising the pilot plant is located in the central shop, which is flanked on both sides by offices and laboratories, with adequate provision for future expansion.

Test specimens are prepared in the machine shop, which consists of modern designs of lathes, milling machine, saws and grinders. The physical testing room is very complete, and houses some rather unusual testing machines. Equipment in this laboratory includes a damping capacity tester, for tests ⅝″ square x 12″ long, for measuring internal friction by the method of free vibrations; a torsion impact machine, for ¼″ diameter specimen; a Brinell hardness tester, 3000 kilogram load; a stiffness tester, 30 inch-pounds; a Rockwell hardness tester; three high speed fatigue machines, for wire up to .125″ diameter; a repeated torsion fatigue machine, for specimens up to ½″ diameter; two fatique machines for specimens up to .400″ diameter, one of which is supplied with a corrosion attachment; a tensile machine, 8,000-40,000 pound maximum capacity, adjustable range; a torsion machine, 10,000 inch-pounds; and a

Steel making facilities in the pilot plant include this 375 pound electric arc furnace which is used for experimental work.

Steel made in the pilot plant is tapped into a small ladle and teemed into ingots.

The larger of the two rolling mills in the pilot plant, this three-high ten-inch mill is capable of reducing a four-inch square ingot to a one-inch square bar.



combined Izod and Charpy impact machine, 240 foot-pounds maximum.

A well-equipped metallographic laboratory is used for studies of material from the pilot plant, and includes, in addition to other apparatus, a microscope with polarized light and dark field attachments, equipped with camera with which micro-photographs may be taken at magnifications up to 4,000 diameters.

In general, the development work is being directed toward improving and controlling the physical properties of carbon steels. Work is being done in the fields of non-aging steels, machinability, and sensitivity to cold working. The research and development laboratory, the result of ten years of progressive planning, will contribute greatly to the progress of improved steel quality.

IMPROVED METHOD FOR WASTE ACID DISPOSAL

▲ The Wean Engineering Company, Inc., Warren, Ohio, leading manufacturer of strip steel pickling equipment, has been licensed by the Allied Development Corporation to make and install waste acid disposal systems by the new process developed by the Allied Development Corporation.

The Sharon Steel Corporation has a plant under construction at its mill in Sharon, Pennsylvania, which, when completed, will treat ten thousand gallons of waste pickle liquor each day.

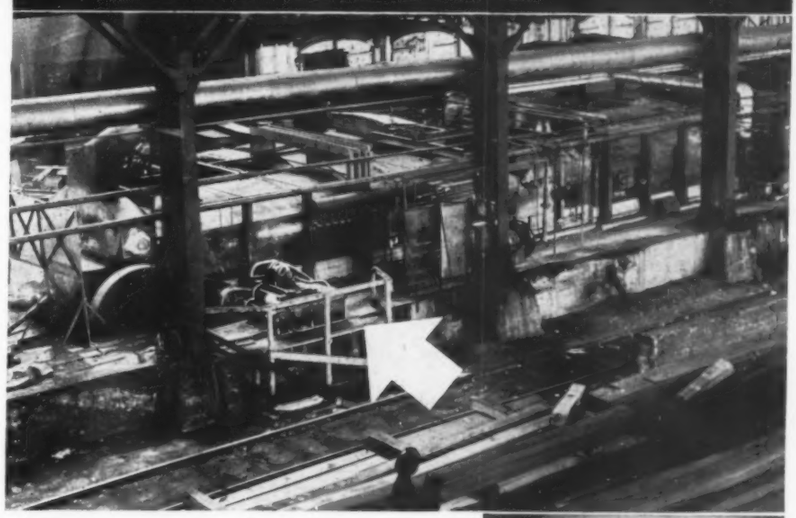
The problem of disposing of waste pickle liquor, which has been a perplexing one in the past, has now become intensified, due largely to the fact that in the large strip mills the acid concentration is considerably higher in the pickle tanks at the time it is necessary to change the bath in order to secure good operating results; also, due to the fact that most plants are now producing some type of alloy requiring acids other than sulphuric. The process developed by the Allied Development Corporation is believed to be the only one that can dispose of other types of acids that are generally used for pickling alloy steels.

One of the outstanding points in connection with this process is the fact that the system will take all the rinse water which normally carries a very low percentage of acid and dispose of same. The disposal of this rinse water, with light acid content, has definitely increased the disposal problem in recent months, for even these small amounts have caused stream pollution and have caused serious objection on the part of state officials.

The process treats the waste acid in such a manner as to create a precipitate which is passed through filter presses. The affluent is clear, uncontaminated water, which can be discharged into sewers or streams without danger of pollution or can be used in internal plant operations.

With the water removed, the resultant product in its plastic form is known as "Ferron". When this material has been formed and dried, it can be used for numerous purposes. The material is fire-proof, has high insulating qualities and can be cut or sawed with ease.

NEW UNIFORMITY IN NORMALIZING RUNS



The modern enclosed design REEVES Variable Speed Transmission. Accurate and positive!

• Primarily to overcome objectionable fluctuation of speed due to heavy loads imposed on d. c. power lines by other plant equipment, a REEVES VARIABLE SPEED TRANSMISSION was installed on the normalizing furnace pictured above.

Other advantages became instantly apparent.

Not only did the REEVES, operating on a. c., provide absolute uniformity of speed, without line-drop, speed drop—but *more accurate setting* of speeds and ease of adjustability contributed, also, to the better quality of finished products. Economy, too, was a factor. The cost of running d. c. lines to the job was eliminated, and a considerable conversion loss was saved. Maintenance costs were greatly reduced.

REEVES ENCLOSED DESIGN TRANSMISSIONS are rapidly replacing other speed control methods in steel plants everywhere. Unaffected by power line loads, by dust, moisture or temperature, they render silent, positive, accurate transmission of speed to driven machines for maximum efficiency at minimum cost.

★ SEND FOR NEW CATALOG G-384 ★

REEVES PULLEY CO. • Dept. IS • COLUMBUS, INDIANA

REEVES SPEED CONTROL

HEAVY DUTY NEEDLE TYPE BEARING

▲ A new type heavy duty needle roller bearing known as The Standard Quill Bearing has been announced by the Bantam Bearings Corporation of South Bend, Indiana. This bearing is the result of many years experience in the manufacture of needle rollers for use in automotive transmissions, universal joints, diesel engine wrist pins and many types of heavy duty machinery. It is said to possess a number of outstanding features, some of which are as follows:

The ordinary assembly of outer race with hardened retaining rings, washers, stampings, etc., has been supplanted by a one-piece, rigid, channel-shaped outer race in which a full complement of small diameter rollers is firmly held.

A Spring steel band is employed to maintain the rollers and outer race as a unit during assembly but is not called upon to carry any load while operating.

The rigid rib surfaces of the outer race are accurately hardened and ground, thereby keeping rollers in perfect alignment. Rollers are correctly proportioned to the pitch diameter involved and are made with husky curvilinear trunnions.

The load capacity is high. Space required is at a minimum.

The design is considerably simplified and all fragile parts have been eliminated. Assembly is very easy. The bearings are available either with or without inner races.

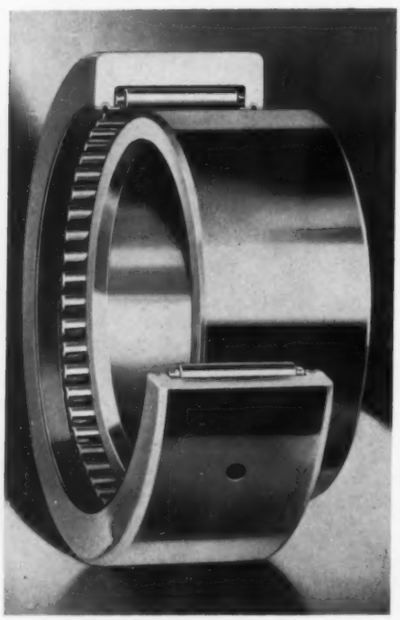
To render prompt service Bantam is carrying these Standard Quill Bearings in stock in a complete range of sizes for shafts from ¾″ to 5″.

Through large quantity production the cost has been brought down to a low figure.

According to Mr. A. H. Frauenthal, General Manager of Bantam, they have in the past years designed and made thousands of these unit type Quill Bearings for specific purposes but until recently had not developed a design sufficiently dependable to offer for general use. Every sound engineering criticism that has arisen in the past years has been eliminated in the present structure.

Bantam has just issued a special bulletin describing these bearings in full which gives complete engineering facts. Users of bearings for heavy radial loads are invited to write the Bantam home office at South Bend for Bulletin No. 103E.

New type heavy duty needle roller bearing for use in automotive transmissions, universal joints, diesel engine wrist pins and many types of heavy duty machinery.



Two draft values, two pressure values, two differential values, or a combination of any two of these three values may be recorded. Hays Draft Recorders are sensitive enough to register accurately increments of .0025 inches water yet are built husky enough to withstand the jars and dirt of steel mill operations.

ACCURATE RECORDING OF

DRAFT, PRESSURE, DIFFERENTIAL

The open hearth furnace is a very leaky structure at best. Therefore, draft conditions within the furnace are apt to be variable. The only way to prevent large leakage of gases is to maintain balanced draft conditions in the hearth.

The *Hays Series OT Supersensitive Draft Recorders* keep an accurate record of draft, pressure or differential—knowledge very essential to effective furnace operation. By connecting the instrument with the risers from the checker chambers to the furnace at a point just above the level of the charging floor a permanent record is made of pressures and drafts at these points. Balanced conditions on each end can be readily obtained and the amount of this draft is an indication of the draft on the bath.

Send for Bulletin 37-232—Write Dept. 7-9-8.

The HAYS CORPORATION
SINCE 1901 COMBUSTION INSTRUMENTS AND CONTROL
MICHIGAN CITY, INDIANA, U.S.A.

A. J. Standing

Past President of A. I. & S. E.

Dies September 2

A. J. Standing, superintendent of the electrical department, Bethlehem Steel Company, Bethlehem, Pennsylvania died on September 2, after a period of poor health.

Mr. Standing was born at Carlisle, Pennsylvania, on May 29, 1884. He was graduated from Dickinson College in 1905 with the degree of Ph. B. After a two year period in the employ of Westinghouse Electric and Manufacturing Company, he entered Lehigh University, receiving the degree of E. E. in 1910. The following year he obtained the degree of A. M. in electrical engineering from Dickinson College, and entered the employ of the Bethlehem Steel Company at Bethlehem as an electrical repairman. He became, successively, assistant electrical superintendent of the Lehigh Division in 1915, superintendent of electrical department, Saucon Division, in 1917, and superintendent of the electrical department, Bethlehem Plant, in 1932.

Mr. Standing was an active member of the Association of Iron and Steel Engineers for twenty-four years, and served as president of the Association in 1928.

ITEMS OF INTEREST

L. M. Ripple, formerly electrical superintendent at Great Lakes Steel Corporation, Ecorse, Michigan, has been made superintendent of maintenance. Mr. Ripple went to Great Lakes Steel Corporation in 1930 from the Republic Steel Corporation in Canton, Ohio. He began his career in the steel mill of the old United Steel Company, in Canton, Ohio, in 1916.

▲

H. E. Meyers has been made general master mechanic for Great Lakes Steel Corporation, Ecorse, Michigan. Mr. Meyers, before going to Great Lakes Steel, was employed by Wheeling Steel Corporation as master mechanic, and also with the American Rolling Mill Company of Butler, Pennsylvania.

▲

L. J. Barko has been promoted to assistant master mechanic in charge of rolling mills, at Great Lakes Steel Corporation, Ecorse, Michigan. Mr. Barko was with the Wheeling Steel Corporation previous to his service with the Great Lakes Steel Corporation.

▲

W. E. Geiselman has been appointed electrical superintendent at the Great Lakes Steel Corp., Ecorse, Michigan. Mr. Geiselman, formerly assistant electrical superintendent, went to the Great Lakes Steel plant from Republic Steel Corporation at Canton.

▲

W. E. Reiber was made assistant chief electrician for Great Lakes Steel Corporation, at Ecorse, Michigan. Mr. Reiber was formerly with the American Rolling Mill Company, at Butler, Pennsylvania.

▲

R. S. McLean was made assistant master mechanic at the Great Lakes Steel Corporation, Ecorse, Michigan. Mr. McLean, formerly with the Wheeling Steel Corporation, went to Great Lakes when that plant was started.

Strickland Kneass, Jr., has been appointed manager of the combustion control department of the Morgan Construction Company, Worcester, Massachusetts. He will have charge of the sale and development of the Isley Furnace Control system. Mr. Kneass has been recently with the Gulf Oil Corporation in Pittsburgh, and previously has had a broad combustion and furnace engineering experience as manager of the Costello Engineering Company and as steam engineer of the Youngstown Sheet and Tube Company.

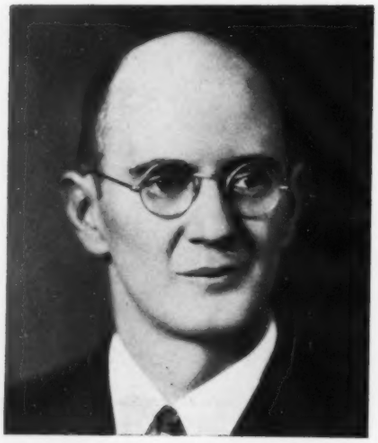
▲

William N. Goggin, of Goggin and Goggin Company, 407 South Dearborn Street, Chicago, Illinois, has been appointed representative in the Chicago district for the Salem Engineering Company, of Salem, Ohio. F. R. Wilson, of 27639 Lathrup Boulevard, Birmingham, Michigan, was appointed representative for Salem Engineering Company, in the Detroit district.

▲

L. I. Barker, formerly manager of sales of the Cleveland district office of the Union Drawn Steel Division of Republic Steel Corp., Cleveland, has been appointed assistant manager of sales, with headquarters at Massillon, Ohio. Mr. Barker takes over the duties of R. B. Barnett, who is leaving Union Drawn to assume the management of the Buffalo office of Peter A. Frasse & Co., Inc. A. G. C. Quay, heretofore a member of the sales force in the Cleveland office, succeeds Mr. Barker as Cleveland district sales manager. Mr. Barker was formerly identified with the Carnegie Steel Co., and began his association with the Union Drawn Steel Co. in 1923 as a salesman in the Cleveland district office. He was made manager of that office in 1929. Mr. Quay joined the Union Drawn Cleveland office in 1927.

L. M. RIPPLE



H. E. MEYERS

L. J. BARKO

W. E. GEISELMAN

W. E. REIBER

R. S. McLEAN

George E. Jurey, for many years works auditor for Jones & Laughlin Steel Corp., Pittsburgh, has resigned, effective September 3. Mr. Jurey joined Jones & Laughlin in 1919, coming from the Republic Iron & Steel Co., Youngstown, Ohio.

▲

L. V. Black has been appointed superintendent of electrical department, Bethlehem Plant, Bethlehem Steel Company, succeeding A. J. Standing, deceased.

L. V. BLACK

Mr. Black was graduated from Penn State in 1914 and went to work immediately for Bethlehem. He worked his way through successive steps to the post of assistant superintendent of the electrical department of the Bethlehem Plant, the post which he has occupied until the present promotion.

Mr. Black has been an active member of the Association of Iron and Steel Engineers for eighteen years and at the present time is chairman of the Philadelphia section.

T. W. Marz has been appointed purchasing agent of the Andrews Steel Co., Newport Rolling Mill Co., Globe Iron Roofing & Corrugating Co., and Newport Culvert Co., Newport, Ky., succeeding the late R. K. Boggs.

▲

Obituaries

Lyle A. Prescott, vice-president of the Blaw-Knox Division of Blaw-Knox Company, died September 7th, following a long illness. Mr. Prescott was a graduate of the School of Engineering of Michigan State University. He had been connected with the Blaw-Knox Company since 1917.

▲

William F. Riggs, superintendent of electrical department, Jones and Laughlin Steel Corporation, Pittsburgh, Pennsylvania, died recently. Mr. Riggs, who was fifty-eight years old, was born in Buffalo, New York. He came to Pittsburgh in 1906, and had been employed by the Jones and Laughlin Steel Corporation since that time. Mr. Riggs had been an active member of the Association of Iron and Steel Engineers, for thirteen years.

▲

George R. Rayner, executive vice-president of the Carborundum Company, died recently after an extended illness. Mr. Rayner was born in Northampton, Massachusetts, in 1871, and had been connected with the Carborundum Company since August 1898, when he came to Niagara Falls as secretary and general sales manager, following a period of sales activity in the Chicago territory. Shortly after the World War, in 1919, he was elected a vice-president of the company, which position he held until his death.

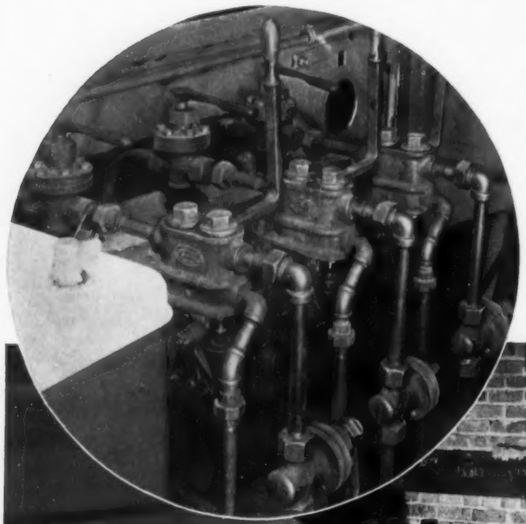
ACCURATE-FAST-SMOOTH and EFFORTLESS CONTROL

with

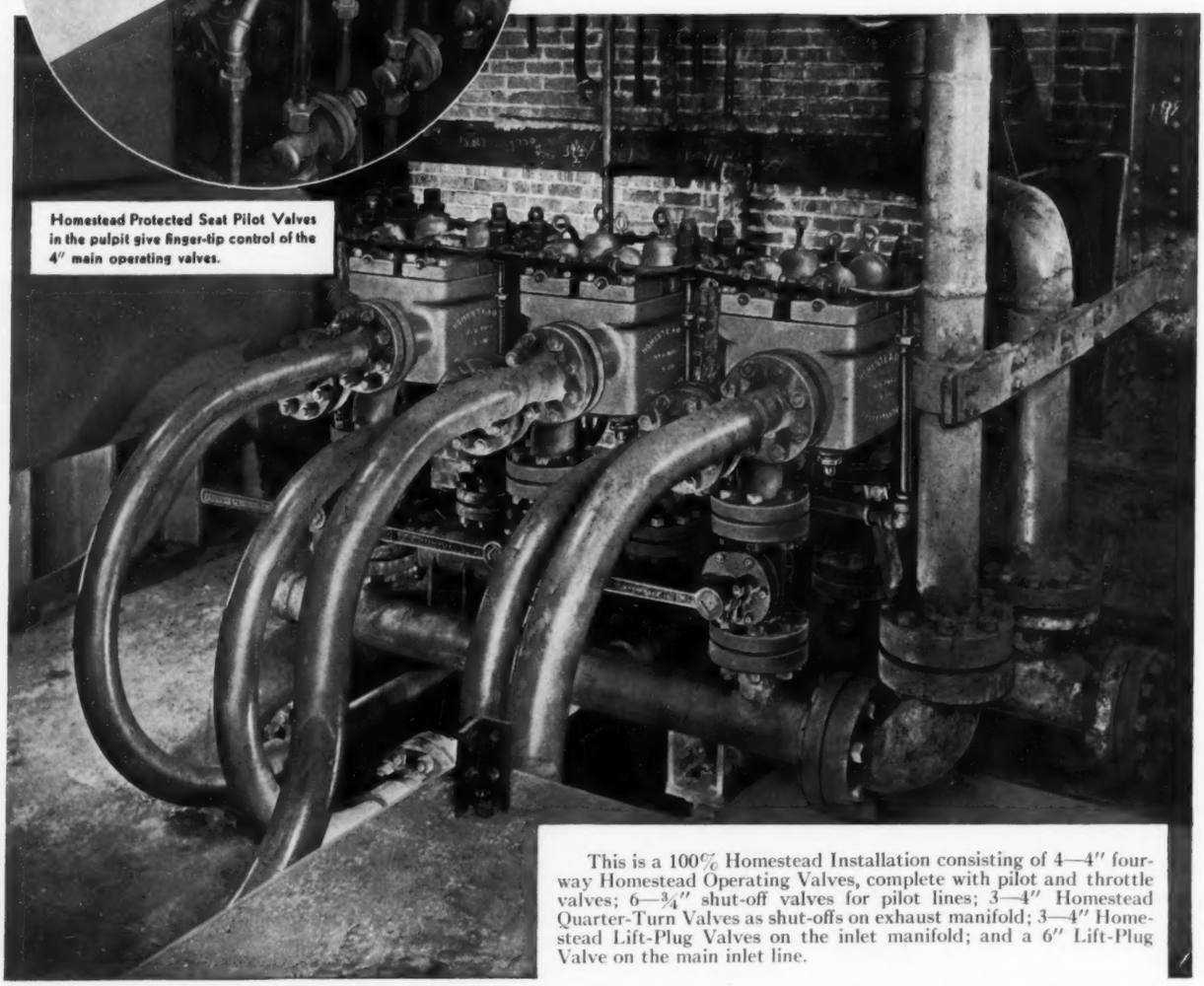
HOMESTEAD

(B&O Patented Protected Seat)

Hydraulic Operating Valves



Homestead Protected Seat Pilot Valves in the pulpit give finger-tip control of the 4″ main operating valves.



This is a 100% Homestead Installation consisting of 4—4″ four-way Homestead Operating Valves, complete with pilot and throttle valves; 6—¾″ shut-off valves for pilot lines; 3—4″ Homestead Quarter-Turn Valves as shut-offs on exhaust manifold; 3—4″ Homestead Lift-Plug Valves on the inlet manifold; and a 6″ Lift-Plug Valve on the main inlet line.

The 4″ four-way hydraulic pilot controlled Homestead Operating Valves, which control the manipulators in this Blooming Mill, are designed to pass 1250 gallons of water per minute without shock, and with extremely low pressure drop. These, we believe, are the largest poppet-type manipulator control valves in service anywhere; and yet their operation is extremely smooth and effortless.

Every feature of these valves is designed to stop costly shutdowns and water losses, and give extra long service at lowest possible operating cost per year.

Write for Reference Book No. 38 showing these and other Homestead products, and let our engineers work with you on your next valve job.

HOMESTEAD VALVE MANUFACTURING CO.

P. O. Box 21, Coraopolis, Pennsylvania